NCER AND FISH: Cancer Research Aided by Fish

# CIENTIFIC AMERICAN

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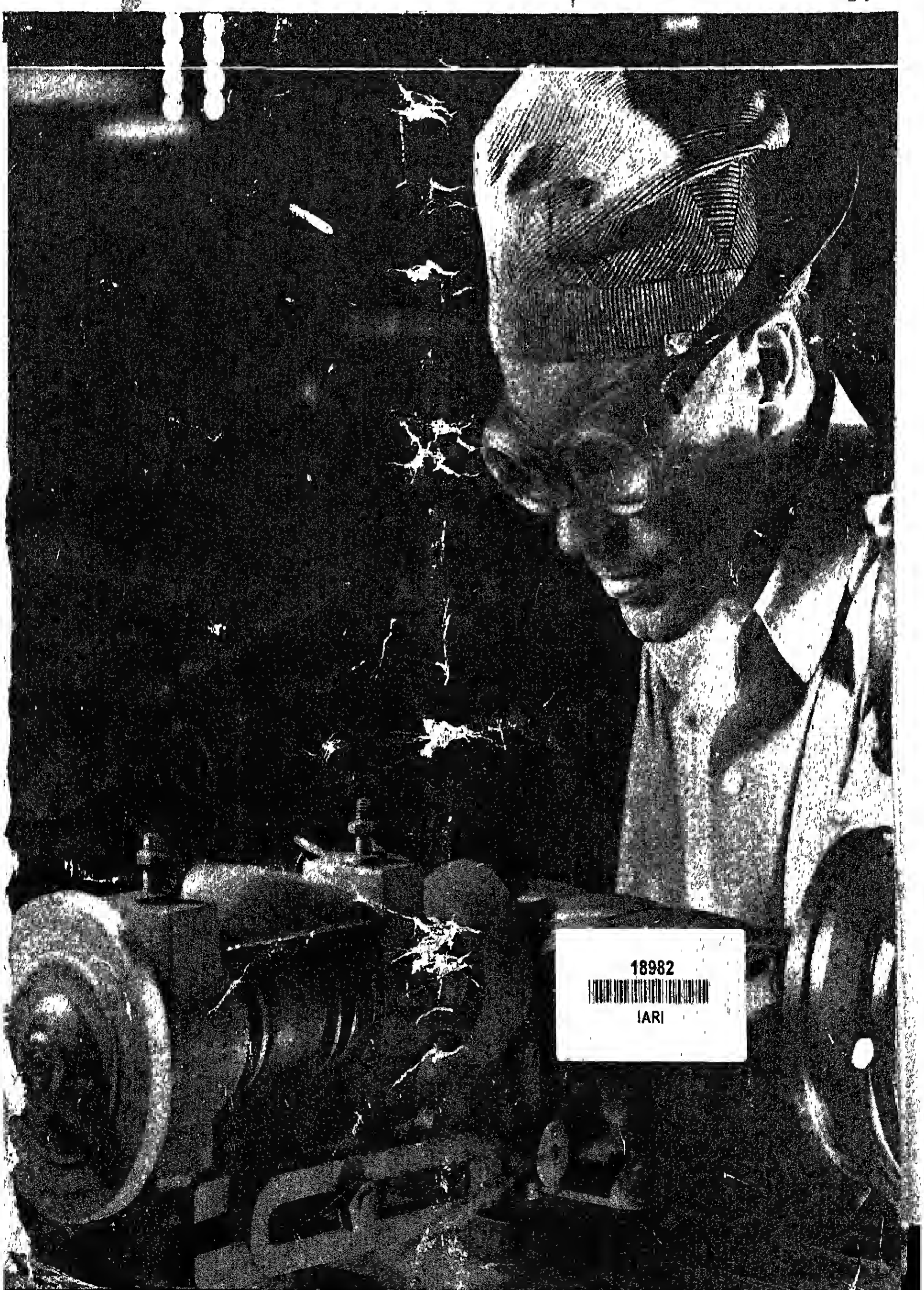

# SCIENTIFIC AMERICAN

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NINETY-THIRD YEAR • ORSON D. MUNN, Editor




## CONTENTS • JANUARY • 1937



18982

DRAMATICALLY symbolizing industry in America, which may be said to be founded largely on the development of machine tools, is the intriguing photograph reproduced on our front cover. Showing a workman in the shop of the Mission Manufacturing Company, Houston, Texas, engaged in grinding a reamer, its prosaic features have been given an unusual interpretation by the art of the photographer, coupled with an appreciation of the subject.

### The SCIENTIFIC AMERICAN DIGEST



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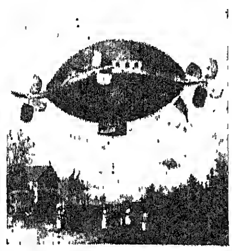
# 50 Years Ago in . . .

## Scientific American

*(Condensed From Issues of January, 1887)*

AIRSHIP—"The accompanying engraving illustrates an aerial vessel and propelling wheel, the invention of Mr. Moses S. Cole, of Greytown, Nicaragua, Central America. . . . It is claimed that this vessel can be raised, lowered, steered, and propelled in any direction at the will of the pilot. The vessel is provided with a central compartment having suitable rooms for the accommodation of passengers and crew. On the top of the ceiling is secured an inflated balloon of semi-spheroidal form. . . . The main driving shaft is placed transversely across the floor, and is formed with a crank at its center, to which the motor is coupled. On each end of the shaft . . . is secured a wheel having several wings, which open and close automatically, according to circumstances; these wheels serve to raise or lower the vessel. Wheels similar in construction are placed at the ends of the vessel. . . . The wheels are each mounted on a shaft having crank arms, which receive a rotary motion from the main shaft by suitable connections. The end wheels steer the vessel in any direction, and propel it in a horizontal plane."



RAILROAD ANCHOR—"The *Railroad Gazette* proposes the following: To have an anchor to drop from the rear end of train and engage with the ties. . . . By having a good long spring to ease the shock when the anchor came to a bearing, in addition to the relief which would come from the draw springs of the entire train without any expense at all, a train might easily be brought to a stop within 15 or 20 feet from an ordinary passenger speed, if something did not give way." (!)

BRICKS—"It may not be known to some what causes the different colors in bricks. The red color of bricks is due to the iron contained in the clay. In the process of burning, the iron compounds are changed from the ferrous to the ferric condition and rendered anhydrous, thus developing the color. Certain clays—like those in the vicinity of Milwaukee, for instance—contain little or no iron, and the bricks made from them are light or cream colored."

PILE DRIVING—"In Pesth, Hungary, dynamite has been successfully used for driving piles. An iron plate 15 inches in diameter and 3¾ inches thick is placed in a perfectly horizontal position on the pile to be driven. A dynamite cartridge, in the form of a disk, containing 17½ ounces of dynamite, is placed on the iron plate and exploded by electricity."

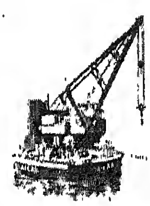
MINICAM—"A remarkable photographic apparatus, to be used for detective purposes or ordinary portrait photography . . . is enclosed in a watch case which opens in the ordinary manner by means of a spring. As the case opens, a miniature camera shoots out for a moment, shuts up again, and the thing is done."

MULTICHARGE CANNON—"Colonel Haskell asks Congress for an appropriation for the further test of the multicharge gun . . . (which has attached) . . . to the barrel, at intervals along its length, a series of exterior powder pockets, that communicate with the interior of the barrel. The ball is started from the breech by a moderate charge of powder in the usual manner; when the ball passes beyond the first pocket, the burning powder fires the charge contained in the pocket, and its pressure is added to that of the initial charge, and so on; each pocket of powder contributes successively to add a new pressure behind the projectile."

BUFFALO—"A gentleman is now successfully domesticating the American buffalo at Stony Mountain, Manitoba. Starting his herd in 1878 with four heifer calves and one bull, it now numbers 61 head; the greater number pure buffalo, the rest half breeds."

FARM SCIENTISTS—"The farmer or his laborers to-day do not one hundredth of the actual work. Steam or horse driven machinery are the agents. The farm is converted into a factory. Grain is sowed and fertilizers are distributed by machines. Improved cultivators are used in treating growing crops. After harvesting by power, thrashing machines are substituted for the old time flails. The farming of 50 years ago is becoming a lost art. To a great extent, the farmer is deposed from his position as the principal producer of a region's wealth. This honor must be shared by others. The chemist has had his part in the change but the inventor stands above all in this. To him the new condition is principally due."

FLOATING CRANE—"This crane . . . has a jib of sufficient rake and height to command the hatches of the largest ocean steamers and is also adapted for lifting dock gates in and out of place for repair. For the latter purpose it was necessary to provide lifting power for 100 tons, with a projection of about 6 ft. over the side. The extreme rake of the jib is 49 ft., which gives a projection of 22 ft. 6 in. over the outside of the fender timbers when the jib is athwartship, and the weight which can be lifted at this rake is 30 tons. Any load between 30 and 100 tons can, of course, be lifted at an intermediate rake."



GREEN RAY—"The green ray is a flash of emerald colored light, said to be observed sometimes for a second or half a second at the moment the sun's disk disappears below the horizon, and just when one sees only a very small segment of its surface."

LICK OBSERVATORY—"The San Francisco *Chronicle* says the crown and flint glasses of the great objective of the Lick Observatory have arrived safely at the summit of Mount Hamilton. The boxes containing the glasses were taken to the south room of the observatory, where a fire had been started hours before to produce the proper temperature."

PATENT SYSTEM—"All who are interested in patents should keep a watchful eye on Congress. At every session efforts are made to secure the virtual abrogation of the patent system, which, if not perfect in every respect, has aided in an important measure in placing the United States ahead of the rest of the world."

### AND NOW FOR THE FUTURE

**TRANSPORTATION is the keynote of our February number—transportation as it affects your daily life and business. Noted authorities on various phases (see note on page 9 of this issue) have prepared articles that are outstanding. If you are not a subscriber, better order a copy from your newsdealer *now*—or, better yet, subscribe.**

# *Personalities in Research*

L. WARRINGTON CHUBB

A VERSATILE and prolific inventor, Dr. Chubb, who is the Director of Research Laboratories of Westinghouse Electric and Manufacturing Company, has 120 patents in his own name, in addition to numerous others developed in his position as Research Director. Electric welding, electric measurements, rectifiers, developments in metallurgy, circuit interruption, radio, electric heating, machine design, development of materials, surge generators, household refrigeration, inverse refrigeration, communication and signalling, electronics, electrolytic treatment of wires, chemical systems for maintaining temperatures, elimination of automobile headlight glare, have been his chief fields of activity. His most important work, Dr. Chubb believes, has been in the development and application of magnetic materials, particularly silicon steel.

Dr. Chubb, who is widely known for his research activities, has contributed greatly to the advance of modern progress. He has been associated with the Westinghouse company since 1905 and has been its Director of Research Laboratories since 1930.

While still a very young man, before most people were thinking of what since has become such an outstanding factor in the growth of American culture and civilization, Dr. Chubb was deeply interested in radio and its tremendous potentialities. When he was still a high school student, he performed his first experiments in this connection; and, later, as a graduation thesis, gave an exhibition of experiments in wireless control, including such picturesque demonstrations as firing a mine, ringing bells, and the like.

Born at Fort Yates, North Dakota, in 1882, he spent his early days at that place, where his father, an army officer, was stationed. After having received his preliminary education, he attended Ohio State University, from which he was graduated in the class of 1905 with the degrees of Mechanical Engineer and Electrical Engineer. In the same year he entered the apprenticeship course of the Westinghouse Electric and Manufacturing Company. When his training in that special course was completed, he was given a position in the company's engineering department, and was assigned to the laboratory of standards.

In 1907, he joined the research division, and carried on in that connection a large number of scientific investigations. Of special importance was the comprehensive study he gave to the preparation and properties of magnetic steel. In 1910 he was placed in charge of the electro-technical section of the research division. In the course of the World War his assignments were largely of a military character, including the invention of methods to detect submarines, the development of new types of underwater mines and bombs, submarine storage batteries, manufacturing problems on small rifles, gas masks, treatment of shells, and shrinking of large ordnance. He was also engaged in the study of various types of apparatus and phenomena as an assistant to Mr. Lamme, of the Naval Consulting Board.

In October, 1919, he represented America as a delegate to the International Electro-Technical Commission in London, England, and again in March, 1920, was sent as a delegate to the meeting of that committee in Brussels, Belgium. In 1920, after the Westinghouse company had definitely entered the commercial wireless field, he was made manager of the Radio Engineering Department. Early in 1930, Dr. Chubb went to Camden, New Jersey, to occupy the position of assistant vice president of engineering of RCA-Victor Company. In June, 1930, he returned to the Westinghouse organization as Director of Research Laboratories.

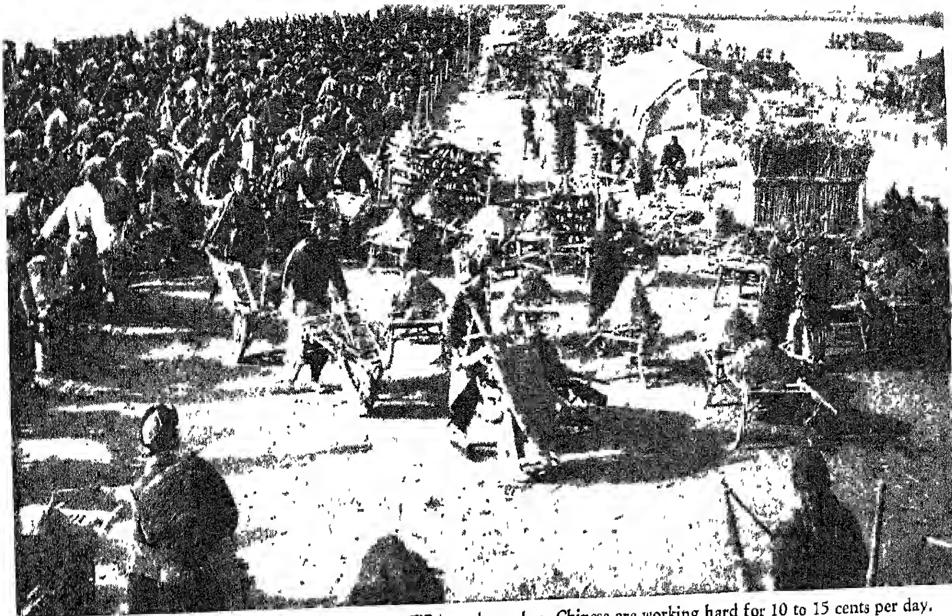
He is a director of Polarized Lights, Inc., and was a director of Audio Vision Appliances and the American Institute of Electrical Engineers.

In the spring of 1933 he was awarded the Honorary Degree of Doctor of Science at Allegheny College in recognition of his outstanding achievements in the field of electrical associated sciences.

It is our happy privilege to announce that, beginning with this issue, our readers will have the benefit of the counsel of Dr. Chubb, for he has accepted the position of Contributing Editor for Scientific American. This appointment has been made in furtherance of our "Research Leaders Help Us Edit" program.

## SACRED SCAVENGERS NOW RESOURCEFUL ENGINEERS

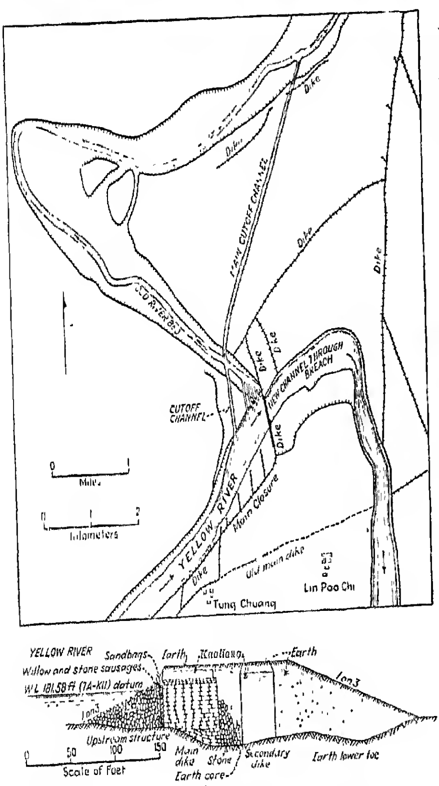
So seemingly intelligent are the antics of those energetic and enterprising insect skatologists, the tumble-bugs, that most persons having the instincts of the engineer or rigger will often spend hours watching a pair of them, male and female, rolling a ball of dung over hill and dale (so it must seem to them) toward some suitable place where the eggs may be laid in it and a safe burial made until the grub of the young hatches. In overcoming obstacles they show remarkable resourcefulness. These familiar beetles are the very same as those depicted in the Sacred Scarabs of ancient Egypt



Tramping on one another's heels, perhaps, but *not* WPA workers; these Chinese are working hard for 10 to 15 cents per day. For half a mile back from the working face of the dike under construction, loaded wheelbarrows occupy all available space

# CHINA'S OL' MAN RIVER

## Yellow River Breaks Dikes . . . Chinese Rebuild . . . Huge Engineering Job Done With Hand Labor . . . Ancient Chinese Methods




Courtesy *Engineering News-Record*

New and old channels and the dike system where the break occurred; also, section of closure dike

By O. J. TODD

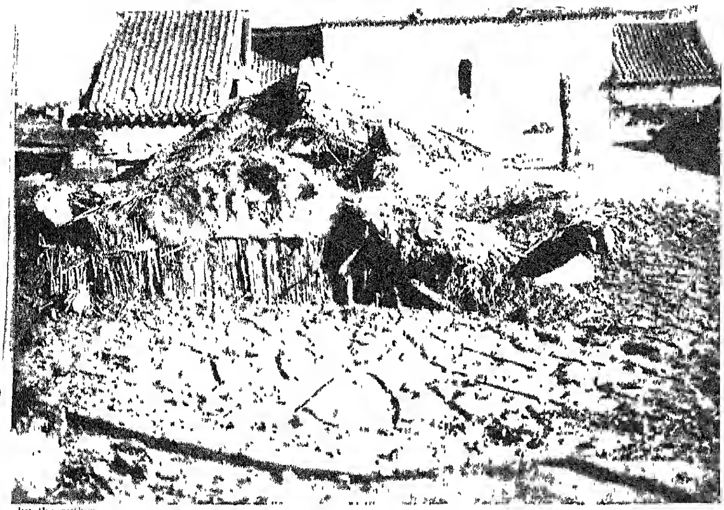
Consulting Engineer to the Shantung Government and the Yellow River Commission, China

THE Yellow River, rising in snowclad peaks of Tibet and flowing for 2700 miles through nine of China's provinces to the Gulf of Chihli, offers a challenge to the ingenuity of man. In the late autumn, winter, and spring it is docile enough. In the summer its dragons writhe, as the Chinese put it, and the battle is on between man and this great mud-carrying stream.

This river has been building up the Great Plain of China for ages by depositing enormous loads of mud on the adjacent lands when, in high flood stages, the earth dikes give way and the silt-laden waters flow over the bordering farming region.

A serious dike break along the lower 400 miles of this river means great disaster to the countryside. The country is so flat that the river does not readily return to its original bed as a faithful horse returns to his stall after a run and roll. After a major break, a prolonged fight ensues before the river is back in its former course. These battles are not easily won, for the scenes of the most dangerous breaks are usually out on the plains that are composed of very fine soil which is easily eroded. There are no hills or rocky ledges to which the repair work may be tied.

The maximum flood of modern times on this river occurred in



by the author

**he taller buildings of Linpaochi survived; others were buried eight feet under mud**

August, 1933, when the peak of the flow passing the railway bridge in Honan was approximately 800,000 cubic feet per second or 50 percent greater than engineers had formerly estimated would be the size of a major flood. This caused dike breaks on both banks near the eastern border of Honan, and the following year further breaks occurred on the north bank nearby so that the only remaining barrier to the north was a badly protected earthen dike. If this should break in time of another major flood, then the city of Tientsin with over a million population would be doomed. The history of the migrations of the Yellow River's course shows that from 2278 B.C. to 11 A.D. this river emptied into the sea across the flats where Tientsin now stands. Thus it now threatens the safety of both rural and urban dweller. In the rainy season it can quickly become a fury whose control is never certain.

WHEN a major flood came out of the loess hills of western Honan down the channel of the Yellow River in July, 1935, lack of vigilance in patrol and an unsuspected weakness in the earthwork caused the south dike to be breached in several places without even being overtopped. The village of Linpaochi near the western border of Shantung Province (a town of 5000 inhabitants) lay across the new path of the river. Now its ruins are being excavated from a soil cover six to eight feet in depth. Deposits of fine silt to a depth of three feet were found 50 miles away from the breaks when the waters receded.

This flood continued through western Shantung and northern Kiangsu provinces until it reached the Yellow Sea, nearly 300 miles from the break, close to the old mouth of the Yellow River from 1324 to 1852. It takes months for the river to dig a new channel even across the Great Plain of China since water is not confined to a narrow channel but spreads out over the nearly level farming country. By January, 1936, the entire river's flow was pouring through a wide breach that then included the several small ones. A great lake of varying width soon developed with a total area of 6000 square miles; and a population of 4,000,000 was directly affected. Here the average farming and village population totals about 700 per square mile. The losses in crops, buildings, and other property totalled 75,000,000 dollars.

**Twisting hemp into ropes by the ancient Chinese method; and, below, the ropeway near the dike job**

When serious breaks of this sort occur along the Yellow River dikes, the majority opinion favors a program of reverting the flow back to the old channel. But many times in China's history such attempts have been unsuccessful, as in 1852 when the lower river swung far to the northeast and has remained there ever since. There were many who advocated letting the river follow its new trend after the last great catastrophe but the authorities decided to use all available means to force the river back into the bed it had left in July, 1935. This work was undertaken in November, 1935, and completed by early April, 1936. It entailed four months of intensive effort by many thousands of men employing methods not familiar to Americans of today yet most practical and interesting.

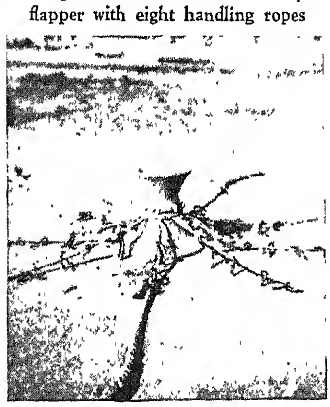
ON our own Colorado River we ha struggled with a similar proble 30 years ago and put that stream under control by using a wooden trestle from which many train loads of rock were dumped to form the core of a rock-fill dam which was later waterproofed. In 1923, I had successfully used a similar method on the Yellow River in eastern Shantung where the problem of throwing the entire river back into its old bed was very much the same as confronted the Chinese here near Linpaochi and Tungchuang in western Shantung. But this time advocates of the old Chinese method, with certain modern improvements, prevailed, and the so-called "contraction" method was adopted. It had the advantage of being applicable in the winter months before it was safe to drive piles for a trestle because of running ice and ice jams. Its greatest disadvantage lay in the possibility that the soil at the closure might be loose and therefore rapid scouring would take place as contraction proceeded. But a good site was found where a sufficiently thick layer of clay prevented rapid cutting of the bed while the closure work proceeded.

Here came the tug of war. During the last month on the job, work went forward night and day to rush the closure of this gap—that at first was a mile and a half across—before the water with its increased speed cut a channel too deep to control. A cold winter that caused the river to be frozen for an entire month so that men could cross freely on the ice, delayed the operations, but with it came low stages of water. Usually spring freshets bring the river up in late March, but this time the season was late and a race was run and won against this spring flood coming down from the melting snows of Tibet. The main closure was effected on March 27th and a secondary dike was completed eight days later. The spring freshet arrived April 12th.

THE methods used were briefly as follows: The old earth dikes were raised and widened, starting well back along the old dike line. This main dike was continued toward the break, working out from both ends with well pounded soil—all placed by hand labor, men carrying the earth in willow baskets or bringing it in by wheelbarrow if the distance was great. In the basket method, each man carries two rather flat baskets, one suspended from each end of a flexible carry pole that he balances on his shoulder. The total weight of a load is about 125 pounds. This is the customary way of handling short-haul earth work in China. The pounding of the earth in place is done in layers one foot thick by use of a stone "flapper" weighing about 80 pounds and tossed eight to ten feet into the air by eight men with ropes so tied to this stone as to move it uniformly up and down.

In all this work, the handling of earth is the largest item whether it be in building up a dike or excavating a channel. Most of it is done on a piece basis by the "fang" (100 cubic feet) or by the cubic meter. As the work advances toward the closure and wheelbarrows

Like tossing a man in a blanket, the flapper is tossed by Chinese to compact soil. Below is the heavy flapper with eight handling ropes



are used for the long hauls, many thousands of men are thus engaged and lines of these barrows are often held up temporarily while other parts of the work are being put in readiness. This is especially true in the wet sections of the dike work where the core of the dike is made of kaoliang (sorghum or tall millet) stalks. At such points the individual often suffers if he is held in line for hours on a cold night yet cannot leave his place and may be allowed to move forward but a few feet at a time.

At the same time the main earth dike is being advanced toward the closure section, a number of spur dikes, or groins, are built out at an angle of 45 degrees pointing downstream to help deflect the current from the main dike. These are faced toward the outer end with stone work.

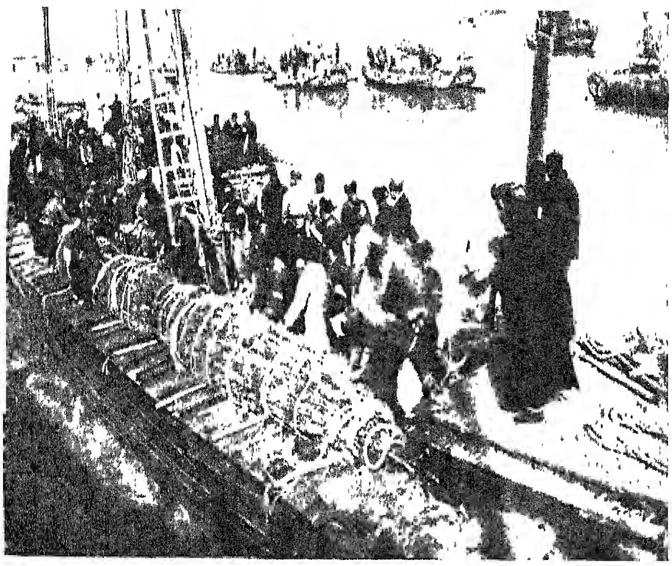
Meanwhile, 600 junks are bringing in stone from a point 70 miles up the river where it has been brought by ox-carts and light railway push cars six miles from a station to which it has been shipped 100 miles by standard railway from the quarries.

Hundreds of carts bring in kaoliang stalks and willow branches from the countryside, and the material yards grow to great proportions. Hemp comes in on wheelbarrows from other farming districts just as it is taken from the stalks by the farmers and dried. A large yard is fenced off for the rope makers and here the hemp is made up into two-inch rope for use in binding together the kaoliang stalks for the core of the dike in the closure section. In this same yard, galvanized iron wire from America is twisted into light wire cables by these same simple twisting devices that the Chinese have used for centuries in making rope.

FOR making the closure where earth work alone would not be safe against possible rises of the river, and where a core must be held in place, two types of construction were chosen, for which a total length of 2735 feet was reserved. Of this stretch of special construction, the last 130 feet of swift-water channel was reserved for the stone "sausage" method which is rather new in China. The rest was done by the kaoliang core method long used in China for dike breach closure.

A kaoliang dike-core is made by placing alternate layers of these dry stalks with layers of earth so that the roots of the kaoliang, which remain on the stalks, always face the upstream and downstream sides of the dikes as the stalks are laid parallel to the [illegible] water.

Making willow fascines in a work yard near the dike



A "sausage" of stones and willow withes, ready to be dumped from a boat

This main core is about 50 feet wide with vertical sides and is carefully tied together in sections 30 to 50 feet in length by hemp rope of one and one half to two inches diameter. On the kaoliang layers, compressed to about three feet in depth, earth is placed to a depth of 12 to 18 inches according to the weight required to sink the mass when pushing it out into the river.

In this work, the coolies must work rapidly, and woe betide a youngster who is slow in dumping his armful of kaoliang stalks. A "river police" foreman will be after him to chastise him for getting in the way, using a kaoliang stalk if he cannot reach him and box his ears. Here the boys do not fare as well as an American mule which has the power to land a telling kick on the boss' ribs. It is all done in good spirit, though the river police are in dead earnest. There is real discipline here and no time for laggards. The river police are the trained river hands with years of experience on maintenance work along this river and attached to the provincial river bureaus of Shantung and Honan. They are better trained than many army men, hard working and reliable.

THE main kaoliang core carries an earth cover about three feet thick when completed to full height. Its upstream toe is protected by heavy stone rip-rap placed on woven willow mattresses that are tied to the main dike by the locally twisted wire cables. On the down-stream face of the dike is a wide earth fill, carefully "flapped" down to make it water-tight. The kaoliang core prevents swift currents from striking this earth water-proofing.

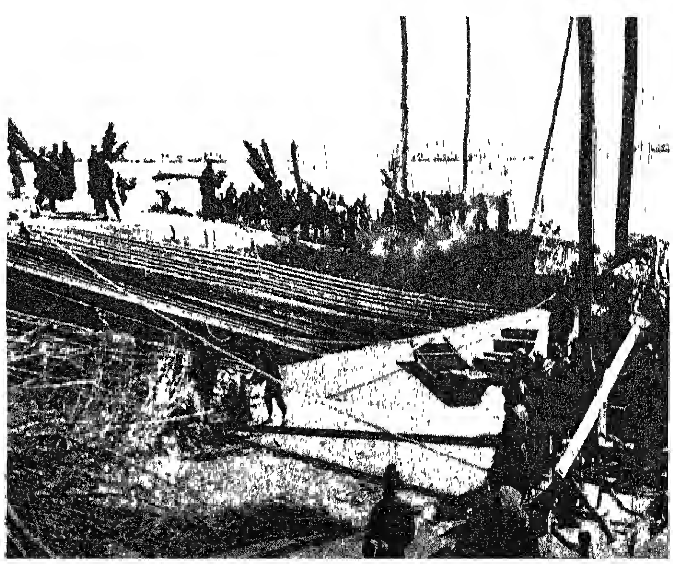
In extending the kaoliang core into the flowing stream, anchor ropes are used, attached to boats held in place up- and on it is a long spar supported three feet above deck. Around this spar are wound the 40 to 50 long ropes that form the cradle into which the 10 foot kaoliang stalks are placed as the work of building up this core proceeds. At frequent intervals hundreds of men are put on the new kaoliang work to jump up and down and settle it into the water as men gradually let out the cradle ropes wound around the horizontal spar on the working boat. In this manner the core of stalks may be settled through 30 to 40 feet of water down into the mud to cut off the flow pretty thoroughly. As the core grows toward completion and the various sets of cradle ropes are tied back into the main dike to willow stakes that act as anchors, other heavy ropes are used to build a sort of breast strap. These are tied well back on the sides of the dike and pass around the face, thus binding the core together as a solid body.

To the American, this type of work seems risky, yet it is done with such precision, and the ropes are tied back with such care, that it is effective. The use of large quantities of loose stone dumped immediately upstream of this semi-permeable core as it advances into swift water is a new precaution that makes this practice more conservative than formerly. It prevents undercutting to any large degree.

But the closure of the last 130 feet was the most thrilling of all. Here the willow fascines, 50 feet in length, were brought in from the work yard and used as casings for the "stone sausages." These were rolled in from the two ends of the kaoliang core to plug completely this last gap where water was flowing swiftly and the final heading up came to six feet, the difference between head and tail water.

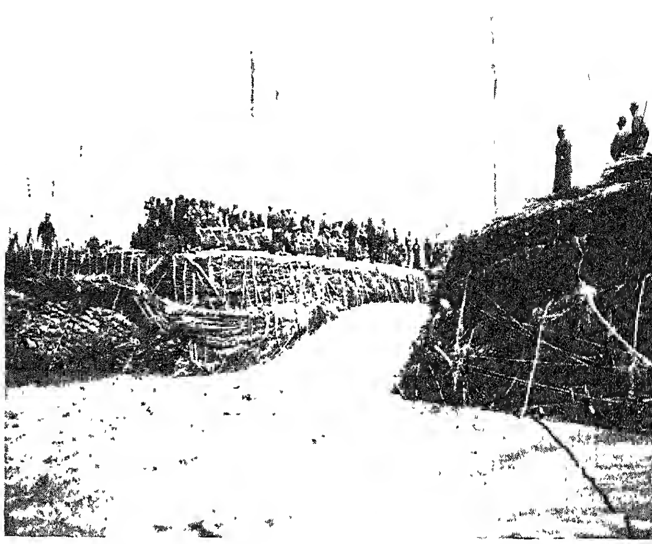
SMALL willow branches were tied together by wires every three feet to make these long fascines that were six inches in diameter. These encased the sausages which were built up at the ends of the dike and on the boats anchored in between. Here men worked feverishly as several fascines were laid as a base, stones were placed on top of them, other fascines were brought in to make the sides and top, and finally ropes were tied around the great "sausage" every three feet of its length. A long heavy rope was woven through the middle to act as an anchor to hold it in place as it was being rolled into the swiftly flowing stream. One must be at the site and see the operation to know how enthusiastically the Chinese river police enter into the spirit of this work.

When 1000 of these sausages had been made and rolled in and the water had become so swift that it took as many as four one-quarter-inch wire cables to hold one sausage in place, the final closure was effected on March 27. As soon as the main flow was cut off (though there was still much leakage) willow branches and



bags of earth were brought on and the closing was completed. Another week of hard work completed a secondary dike and did the necessary waterproofing. Then earth was added to give further weight to tighten up the voids. Another week of hard work was necessary to complete the secondary dike which was closed by an old fashioned kaoliang plug lowered by ropes released simultaneously from the two sides. This method is used when moderate quantities of water are being blocked off and depths are not excessive. Finally, practically all leakage had ceased.

In the meantime, the water in front of the closure section had risen five to six feet above the winter stage that it had maintained. It was forced through the old channel where heavy silt deposits lay and through a new cut-off channel that had been excavated by 20,000 workers with picks and shovels in frozen ground in February and March. Gradually the water cut away the silt in the old bed and the river resumed its old course with little to obstruct its flow.



A torrent pours through the narrow gap on the final day

EVERYWHERE hand labor prevailed, if we except two small pumps for removing water when excavating the channel damp and a hundred dump cars with track used to bring bags of earth along the main dike to help in the closure. Common labor is plentiful and cheap in the Great Plain of China, generally being 10 to 15 cents per day in our American currency.

Under the eyes of the Shantung and Hopei river police who are experts in the handling of both men and the local materials used, these low-wage laborers do a thorough job in the fashion followed by their ancestors for hundreds, perhaps thousands of years. Under them, work goes forward with a system no less remarkable than it is strange to the occidental. Since the materials used—stone, earth, kaoliang stalks, hemp, and willow withes—are local products and are not factory processed, the wise oriental—in a sense—sets nature to combat nature.

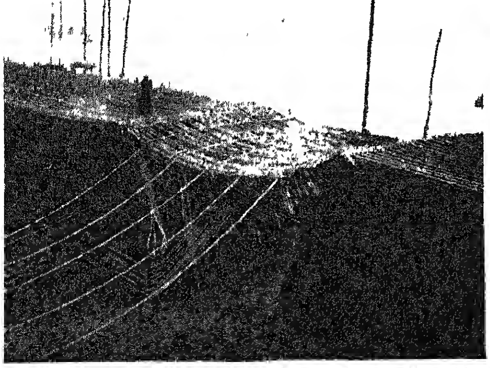
More than 1,400,000 cubic feet of stone were used on this work; 300,000 burlap bags were filled with clay and used at the end to complete the closure; 15,000 tons of dry kaoliang stalks went into the core of this dike in the wet section less than 3000 feet in length. The willow used for fascine and mattress work weighed 4500 tons. A total of 1000 tons of hemp rope was made on the job and used to tie the kaoliang stalks in place, while 2000 tons of American wire went into the small cables and the willow mattresses. Ninety thousand willow stakes were used to anchor the ropes and wires. The earthwork in the dikes totalled nearly 25,000,000 cubic feet while nearly 20,000,000 cubic feet of clay and silt was the total excavated by hand and carried out in baskets in digging the long cut-off channel. Native picks, shovels, and wheelbarrows were the tools most used in performing this feat of putting the Yellow River back in its channel.

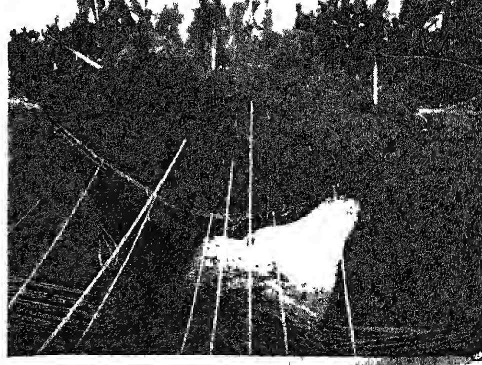
The descendant of Confucius who successfully accomplished this work of closure and led the army of workmen that totalled 25,000 at one time, was Chief Engineer H. Y. Kung of the Yellow River Commission.

It was a great privilege to be a foreign adviser on this work and note how excellently the Chinese have learned to meet these emergencies with methods and materials at hand and how they have learned to use that great and powerful asset of China—man power—for it is with this that they do these difficult tasks and at low costs. The entire cost of this work was around 800,000 dollars U. S. currency.

●

*I. B. Babcock, Walter P. Chrysler, Reginald M. Cleveland, J. J. Pelley, Kermit Roosevelt, Philip H. Smith, and Alfred H. Swayne—an imposing group—are the authors of the seven feature articles, on as many transportation subjects, coming in our February "TRANSPORTATION NUMBER." They will bring you up to date on Buses, Automobiles, Air Transport, Railroads, Ships and Shipping, Trailers, and Highways. In addition, the issue will carry the usual significant science.*—The Editor.





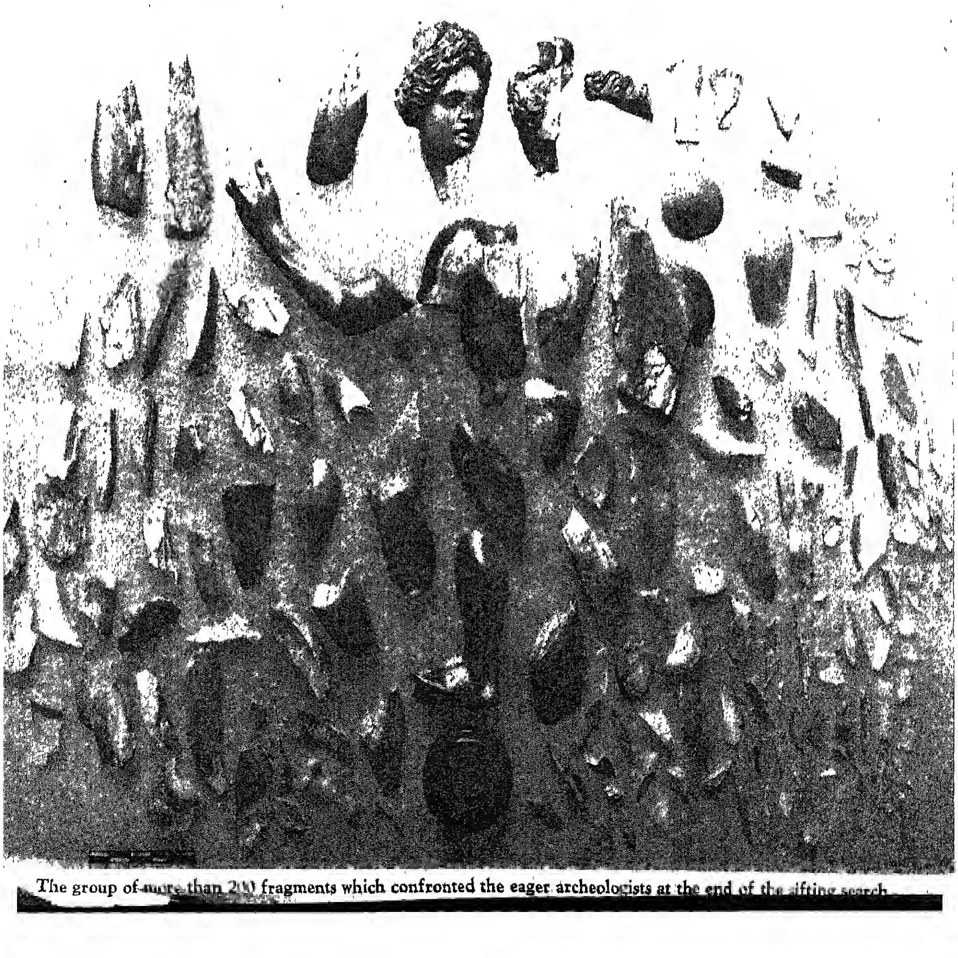
... ready for closing the secondary dike; and, at right, the kaoliang plug is bei... thereon

courts will not sustain it, ... invalid patent should not At root, the cause of war has nothing man is chained to his own n...

Showing "unmistakable characteristics of the style of Praxiteles"

# ARCHEOLOGIST'S PUZZLE

IN several recent instances the scientific prestige of old classical writings often thought of as possibly inaccurate has been enhanced when things described in them thousands of years ago have actually been dug up by modern archeologists. Lucian, an ancient Greek writer, described a certain statue of Apollo at Athens as (1) leaning against a column, (2) holding a bow in the left hand, and (3) having the right hand on the head. Recently the American School of Classical Studies at Athens, led by Prof. Leslie T. Shear of Princeton University, was excavating in Athens and found many wells and cisterns. In one well 50 feet deep a head, an arm, a leg (see the lower photograph) of what appeared to be an ivory statuette were found in the mud that filled it. Therefore every ounce of earth removed from the well was eagerly sifted and over 200 fragments were found. The account is given in *The Illustrated London News,* from which the illustrations are taken by kind permission. No picture puzzle could furnish the intense interest afforded the archeologists as they set to work piecing together the three-dimensional puzzle shown below. With the help of a few fill-ins—a part of the stomach, bits of the right leg, two fingers—the Apollo statue was fitted together and proved to be just under one foot in height. That it agrees with the ancient description given by Lucian seems evident from (1) a spot on the back of the left shoulder where it was "leaning against a column," also the round base of the column, shown near the bottom of the page; (2) the position of the fingers, loosely holding a bow while the Apollo rested after shooting, with (3) his right hand on his head. These "tie-ups" may prove that this is the statue Lucian saw. Experts in the study of Greek sculpture abundantly confirm the attribution of this work in ivory to the great Greek sculptor, Praxiteles, maker of many masterpieces.



The group of more than 200 fragments which confronted the eager archeologists at the end of the sifting search

# OUR POINT OF VIEW

## Fewer Patents?

APROPOS of current agitation directed toward raising the standard of inventions for which patents are issued by the Patent Office, and the suggestion that patents be issued only for important inventions, it should be noted that under the law as it now stands the Commissioner of Patents may grant patents only for something for which "the claimant is justly entitled to a patent under the law" and which "is sufficiently useful and important."

Every patent that is issued, no matter how insignificant and frivolous its subject matter may appear to some persons, carries the legal presumption of validity, since it may be assumed that the Commissioner of Patents has found that the inventor "is justly entitled to a patent under the law" and that he has also determined that the invention is "sufficiently useful and important" to justify issuing the patent.

It is not surprising that patents are frequently issued for things which prove to be unimportant and lacking invention; but who is competent to judge accurately the value of an invention at the time a patent is sought?

Instead of making it more difficult for the inventors of simple devices to obtain patents, the Patent Office should be more liberal. With no background by which to determine the effect of a new patent on industry, it would seem to be almost impossible to determine correctly its degree of usefulness and importance. Many patents, differing from prior patents only in slight degree, have been issued and later found to be highly valuable. For example, locating the eye in the pointed end of a needle instead of the blunt end, at the time it was done did not seem to be a very important invention, but it was the invention which enabled industry to produce a successful sewing machine.

It should be remembered by those who are insisting that patents be issued only for important inventions, that when an invention is first conceived and reduced to practice many are skeptical as to its value and importance. It is only by receiving a patent for his invention that the inventor will have the opportunity of proving the practical value of his invention to industry; it is the evidence of such value that leads the courts to decide for or against the validity of the patent.

An invalid patent hurts no one, for the courts will not sustain it, but the fear of getting an invalid patent should not justify the proposed change. It would be much better if the Patent Office adopted a general rule that every new thing—something that a diligent search of the prior art shows to be new—should be given the benefit of the doubt, and the applicant should receive his patent. This plan would save a great deal of argument on the part of the Patent Office on one side, and the applicant on the other, on the question as to whether or not what the applicant has done really amounts to invention. Novelty creates a presumption of validity.

## What Can Science Do?

WHEREVER men of science gather for discussion today, whether formally in conventions or informally in limited groups, or even casually in twos and threes, one significant subject usually comes in for debate—the glaring misuse and prostitution of the great gifts that scientists have made to the world. As never before in the world's history, war today is a direct application of science —or rather, a direct perversion of it, for in all the world no group of men can be more peaceful by nature than its scientists. Their gifts were intended to enable man to create and enjoy, but the world quickly converts them into agents of destruction; intended to enable man to live more happily, they are perverted into agents of death. The knowledge of chemistry and physics turns into a technique of destruction with poison gas and projectile. The invention of the airplane results almost at once in the provision of a speedy factor in warfare which leaves almost no man on earth the privilege of going to sleep for even a night without the fear and knowledge that death on wings may overtake him in his bed before morning.

The most recent by-product of the growth of science, some think, is the totalitarian state with its pugnacious, bristling aspects. Not that science is the direct cause of the totalitarian state; it merely favors its growth. Instantaneous means of communication—the telegraph, the telephone, the radio, gifts of science —assist strong men to dominate, as never before, large groups of human beings (none of the great empires of the past was comparable in population with the nations of our times). Strong men are but the expression of the urges of whole peoples, and the forces made available by science have merely implemented these forceful characters.

At root, the cause of war has nothing to do with science; it is as old as mankind. Speaking before an assemblage of chemists, Dr. Gilbert J. Fowler recently described the roots of war in terms of three lusts—the lust for *power*, the lust for *prestige* and the lust for *possession*. Of these, the last named is probably the least. All three lusts will doubtless pertain to man as long as man pertains to the earth. Thus, to face reality, it seems quite possible that a long procession of dominants, armed and greatly enhanced in power by the resources of force afforded them by science, will be likely to infest the future. What could Alexander, Julius Caesar, or Napoleon not have "accomplished" with these resources!

Since it seems unlikely that so fundamental a change in the "nature of human nature" as the destruction of the three lusts can be effected, and since there is no way for science to recall to its laboratories the various tools it has given the world only to have them seized by the lustful, what then is left? Some are saying that science "should do something about it." New discoveries should be released only under certain safeguards. A little thought shows how impractical are such hopes; there is no way to give out a discovery yet restrict its use rigidly to peaceful purposes. Others are saying that men of science themselves should assume direct responsibility in connection with the control of their discoveries after they have left the laboratory, and not merely turn out new things and then forget them while working on more new things. But scientific men as a whole are the last type on earth either to desire to direct or to know how to direct the rest of the human race; they are a type apart, their minds functioning in so different a manner as seldom to understand the world or be understood by it (briefly, rational rather than emotional).

Where, then, is the solution?

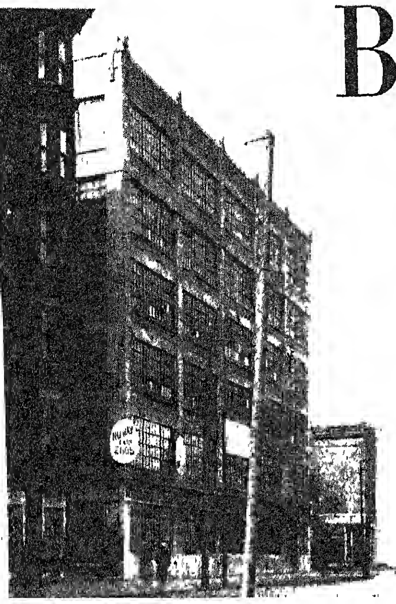
Pessimistic as it may seem, to end on a minor note, there may really be no solution at all; not all problems have solutions. This is realism, of course, and it offers unpleasant thinking. Must our children and their descendants then pass through as endless ordeals of future fear and furore as our ancestors? It is possible that just this will be the sad truth. Man is the only animal which seeks to end war at all, for all the other animals have war at all times. But man believes he is "higher" than the animals, and in one way he is. In another he is not.

Probably in a case such as this there is nothing that science can do, as long as man is chained to his own nature.

# Broiler Factories

## Eggs and Broilers in Mass Production . . . Thousands of Hens Indoors in Cities . . . Scientific Management . . . Controlled Food, Climate

By PHILIP H. SMITH



This might be almost any kind of plant, but the egg sign identifies it as an egg factory

FACTORY-MADE eggs and broilers are here. Chicago boasts three factories, one in the congested loop district housing 23,000 hens on six floors. A prominent hotel on the Atlantic seaboard has a roof-top plant from which broilers go down a chute to the kitchen. By the time you read this a race will have been decided as to whether a 50,000 or a 123,000 hen factory will be the next to open. Both are being engineered, and both will be metropolitan enterprises, not suburban.

These many projects are not merely novelties to flower in news photographs and then wither; 10,000 of them, large and small, are operating. They represent the practical fulfillment of an idea that one branch of farm activity could be industrialized and moved bodily into the heart of big cities to achieve great economies. That the move runs wholly counter to the much touted, little practiced idea of industrial decentralization only adds to its significance.

Large-scale factories are feasible today because the problem of establishing a complete control over the onery hen has been approached scientifically and the obstacles eliminated one by one. The only thing left unplotted is the managerial problem, which contributes to make this business comparable with all industry.

Battery brooding, as the system is called, involves confinement of the birds in wire cages from the first day of life until they cease producing eggs or have reached the proper weight for marketing. During their life span the birds are routed through three departments—starting, growing, and developing. When the males are sold as broilers, the females are carried on to a fourth department—laying. At each stage, the number of birds per cage is reduced until the laying bird has a cage of her own. Once isolated, she becomes a producing unit. As the egg is laid it rolls out of her reach into a tray to be recorded and collected. The minute her egg production drops below a predetermined standard, she is marketed for meat and her place is taken by a better worker.

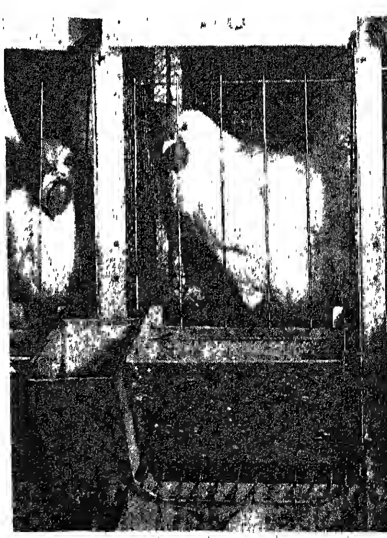
The cages are so designed that the birds stand upon wire mesh and reach outside for their food and water. There is no litter to be scattered, nor can the food and water be wasted. Every ounce of mash goes to make meat or eggs. The droppings fall through the wire onto endless belts and are disposed of by winding up the belt against a scraper superimposed on a pan. The cages are built in units, four tiers high, to economize on space and permit easy handling.

The first question which is asked about this factory system is: "Don't the birds suffer from lack of exercise and sunshine in their confinement?" Agricultural experiment stations have pondered this same question and so did the people who developed the system. When confinement in cages was first tried, the birds suffered from rickets, but experimentation proved that it was the lack of sunlight which caused the trouble and this difficulty was ironed out by feeding cod-liver oil in the diet to provide vitamin D. Since then no physical ailments have been detected, though many generations of confined birds have been studied.

Another problem confronting experimenters was to curb cannibalism. Birds are especially prone to it when confined by the hundred as day-old chicks. The solution amounts to a trick. Ruby-colored glass at the windows and similarly colored light bulbs ended all the trouble. It was suspected that cannibalism was induced by the sight of blood where the pin feathers came through the skin and confirmation was had when neutralization of the blood color ended the practice.

THE caging of birds provides an excellent control over many diseases. Standing the birds on wire, for example, gets them away from soil and litter which are disease carriers. Sectional or unit water supply is another aid to prevent the spread of trouble. On the other hand the *confinement system requires* watchfulness in other directions. Experimenters found that great care must be taken to insure an adequate supply of oxygen for each bird. A certain number of cubic feet of air must be given each bird if it is to thrive and produce efficiently, and this calls for a controlled ventilating system.

The advantages of the factory system



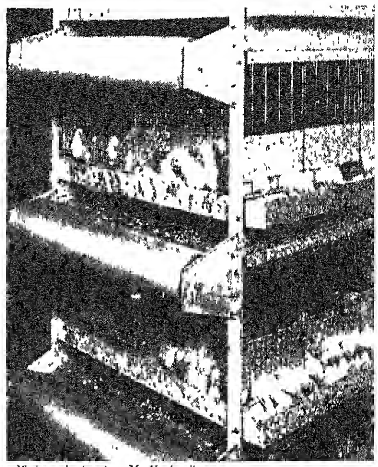
Healthy and contented, good layers spend their entire lives indoors in well-kept cages

over the range-kept method have been definitely established by prolonged test. Under controlled conditions of temperature, light, and humidity, production can be stimulated and maintained as a constant throughout the year. Artificial light provides a 13-hour working day; temperature and humidity controls eliminate the winter influence and there is no longer a seasonal fluctuation in output. This permits close control of costs, allowing for long term sale contracts at established prices. Feeding costs can be lowered because there is no scattering of the rations. The mash is always available to the bird, and intake and output ratios can be determined. Litter is eliminated, thereby simplifying the maintenance of sanitary conditions.

THERE are two more economies inherent in this factory system which cannot be enjoyed with the old, open-range system. The first is economy of land. Under natural conditions there is a limit to bird density per acre, roughly figured at 100. That is to say, 100 is nature's figure and to exceed it is to encourage the rise of diseases. With the factory system, the only limit of density is the economic one of land and building costs, taxes, and so forth. At the M. H. Arndt experimental plant, where this battery brooding system was pioneered, 16,000 birds are housed on less than one acre and all labor is performed by two men.

A second economy arises from the conservation and utilization of droppings. Droppings have a definite value and complete salvage not only conserves resources but increases factory revenue. At the above mentioned experimental plant the sale of droppings to nurserymen pays the total labor cost.

The egg and broiler factory has far-reaching significance not alone because it threatens a revolution in the chicken business, but because of its effect upon other industries, notably railroad and cold storage. The system makes possible production close to the centers of consumption, thus reducing transportation needs with accompanying gains in freshness of product and lower breakage losses. Growth of the factory idea would bring about definite shifts of producing centers. At present, production and consumption are widely separated. For example, along the northeastern seaboard, which embraces coast cities from Boston to Washington, 30 percent of the nation's eggs are consumed, yet within that territory no more than 14 percent are produced. The Pacific coast states shipped 38,000,000 eggs solely for New Yorkers in 1934. Common sense says: ship the feed from the low-cost producing centers and not the perishables. The cold storage industry would be affected likewise. Controlled conditions of production which eliminate the seasonal influence in output, void the very reason for storage.



Photographs Courtesy M. H. Arndt

Youngsters that will never scratch gravel. The belts to catch valuable droppings are shown

The growth of the factory idea can be gaged from the fact that there are already more than 10,000 installations, for the most part of moderate size. But as yet only 4,000,000 of the 400,000,000 birds in the United States have been caged. The most striking thing is the marked tendency for the size of producing units to be expanded and to utilize multi-story buildings in the heart of cities rather than on the periphery. The profit per hen per annum, which can now be figured closely, does not permit the erection of new structures in congested areas. The establishment of city factories depends upon being able to rent or purchase obsolete structures which no longer have economic value for other enterprises.

Row upon row of cages house thousands of hens in factories that are keyed to mass-production. Careful scientific supervision assures pre-determined results

COMMERCIAL practicability is an established fact, but there remain many researches to contribute to the further success of battery brooding. Experimenters are trying to breed birds that thrive better in confinement. "Confinement minded" is the phrase being used to express this objective. There is much in the physical structure of a hen which does not contribute to egg production or to the prompt development of flesh, hence breeders aim to eliminate the non-essentials and fit the bird to the cage and its life work. Finding incentives to lay is another object of study. Music has been tried and, strange to relate, increases production.

Better utilization of waste and by-products, being an aim of all industry, applies as well to the egg factory. Here an attempt is being made to make better use of droppings as a fertilizer. The material is strong in ammonia and a great deal of its content is highly volatile. One experimenter is now trying to capture and retain these volatiles by placing chemicals on the belts under the cages so that a chemical union will be formed while the droppings are fresh.

Of course, institution of the factory idea intensifies the commercial elements of merchandising, financing, cost accounting, and so forth, but this is also indication that industrialization of the hen has successfully modernized the poultry business. Trial and error has accomplished this transition.

# ROTATING ROCKS

By HENRY NORRIS RUSSELL, Ph. D.

Chairman of the Department of Astronomy and Director of the Observatory at Princeton University Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington. President of the American Astronomical Society.

THE simplest questions which the astronomer is asked sometimes turn out to be the hardest to answer; for example, does this planet rotate? How long does it take to turn around? And in what direction is its axis?

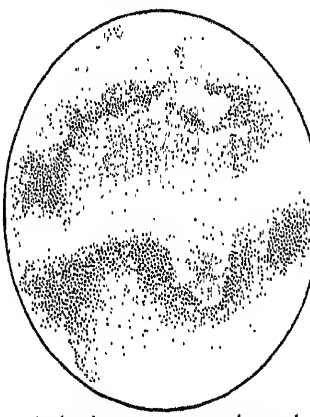
There is but one of the many planets for which we can give precise answers. This, of course, is Mars. His surface is plentifully adorned with permanent markings. A single night's watching shows them moving across the disk as he rotates: The next night shows them back where they were after an interval of a little less than 25 hours and by comparison of drawings made farther apart in time the exact period has been determined as 24h 37m 22.58s. The white snow-caps locate the poles roughly at a glance and measures made on them, especially when they are small in the planet's late summer, give a precise determination.

Jupiter looks larger than Mars with the same telescopic power and has even more conspicuous spots. In a single clear winter night one may watch the planet turn completely around before one's eyes. But when it comes to accurate work it is found that spots close to the equator complete a circuit in 9h 50m, while those in higher latitudes take five minutes longer. Different spots in neighboring zones show somewhat different periods. Evidently they are cloud forms carried by prevailing winds in Jupiter's atmosphere. Even the Great Red Spot, which has remained visible for the past 70 years, has changed in rotation period by several seconds—so that it can not be attached to a solid core though it is probably "rooted" in a region of viscous material where currents are slow.

PROBABLY not many of us realize that the earth, for an imaginary telescopic observer on Venus, would behave in the same way. Its most conspicuous surface markings—after the reflection of the sun from the ocean—would be the great cloud areas that go with storms. In temperate latitudes these move eastward by several hundred miles a day and would appear to the distant observer to complete a revolution in 23½ hours or less. In the trade-wind belts of the tropics the winds blow from the northeast and southeast, and if specific markings could be detected in the sea of broken clouds they would indicate a period of more than 24 hours.

Saturn shows plenty of telescopic detail but this is usually in the form of broad diffuse belts parallel to the equator, with no markings which could be followed as the rotation carries them around. Three or four times in a century conspicuous white spots have suddenly appeared and lasted for weeks or months. One near the equator gave a period of 10h 14m—another, 36 degrees away from it, 10h 38m—so that the winds which drift these clouds must blow even harder than on Jupiter.

Mercury is so near the sun that his surface can be observed only in broad daylight and usually through unsteady air. Under good conditions faint markings are visible—and these by the general consent of observers show that this



A drawing to represent the earth from space. Clouds veil much of the surface except in the trades, and these clouds are excellent reflectors. The dazzling ocean reflection (see the text) not shown here

planet always turns the same face towards the sun as the moon does towards the earth.

Venus, though she shows a large and conspicuous form (often a crescent) with a moderate telescopic power, still hides the secret of her rotation from us. Her white surface shows a very beautiful gradation of light, fading out toward the terminator where the sun's rays graze the surface—and nothing else. On rare occasions faint and elusive markings have been reported but they are not definite enough to follow from day to day. With ultra-violet light, Ross has photographed conspicuous dark areas. These change from one night to the next and must be due to some sort of clouds or haze, but they change so much that they cannot be identified after 24 hours. Moreover, there is only an hour or two, at best, in any one night between the time when the sky gets dark enough to permit ultra-violet photography and the setting of Venus into the haze of the horizon, so there is no help here. The spectroscope shows only that the rotation is too slow to get up a measurable speed at the equator. It is certainly much more than a day—indeed more than a fortnight—but anything exceeding a month would be unobservable.

Radiometric measures show that the dark side of the planet sends out an easily perceptible amount of heat—which would not be the case if, like Mercury, Venus kept always the same side toward the sun. If, when the planet appears as a narrow crescent, heat measures were made for different parts of the dark side, we might be able to distinguish the sunset from the sunrise edge and so find out at least in which direction she is turning.

Uranus is so far away and so feebly lighted by the sun that it would be hard to see spots on his surface unless they were large and contrasty, but his rotation can be determined in four ways. First, the planet, when seen from the direction of the plane of the satellites' orbits, shows a conspicuous polar flattening—which can be due only to a rapid rotation. Second, the orbit of the innermost satellite shows a forward motion of the point of closest approach to the planet, which would not occur unless the latter was flattened at the poles. Third, spectroscopic observations indicate an approach of one side and recession of the other at a rate corresponding to a period of about 10¾ hours (Slipher, 1912). Fourth, measures of the planet's brightness by Leon Campbell (at Harvard in 1916) show a variation of about 15 percent, repeating itself in 10h 49m. A more convincing array of evidence could hardly be desired. Yet later photometric observations in 1917 showed a smaller change and those of 1918 and subsequent years show none.

THIS, however, is not real evidence in rebuttal for it is entirely reasonable to suppose that a spot on the planet fairly strongly marked in 1916 gradually faded out, as spots on Saturn have been seen to do much more quickly.

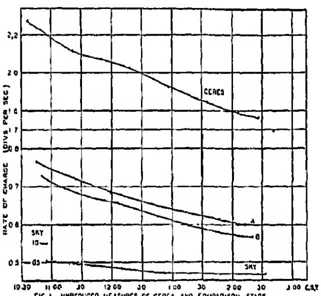
Accurate photoelectric measures of the light of Uranus were made by Calder

# Photoelectric Research on Some of the Pocket Planets Throws Light on Their Brief Rotation Periods . . . Some Not Round but Elongated Splinters

at the new Harvard station at Oak Ridge in the winters of 1934-35 and 1935-36. These showed but small fluctuations with an extreme range of 5 percent. To extricate a real but small change in the planet's brightness from the effects of the errors which are inevitable even in these excellent measures is difficult. But Sterne has shown recently that; if the observations are "assembled" on the assumed rotation period of 10h 49m, the measures taken when the planet should have the same side toward us agree with one another decidedly better than they do with those when it should show us another face. There is less than one chance in 20 that this would happen by accident, and the rotation period found 20 years ago is thus confirmed. On repeating the calculations, but assuming the period to be 1½ minutes longer or shorter, nothing but random fluctuations were found; so it looks as if the period were pretty closely known.

Neptune's satellite, too, shows slow changes in its orbit, which can be explained only by polar flattening of the planet—though to a much smaller degree than for Uranus. This indicates a slower rotation, but we cannot calculate just how much slower, for the flattening depends not merely on the rate of rotation but also on the degree to which the density inside the planet increases toward the center. The spectroscopic observations of Moore and Menzel (1928) indicated a rotation period of 15.8 hours and showed to everyone's astonishment that the planet rotates forward (that is, in the direction of its orbital motion) although the satellite revolves around it backward.

WHEN we come to the tiny asteroids, most of these methods fail us. All but a very few appear as mere specks, even with the greatest telescopes, so we cannot hope to see spots on them, detect whether they are flattened at the poles, or feed the light from opposite sides of the infinitesimal disk into our spectroscopes. One recourse alone remains but it is a powerful one. The light of an asteroid can be measured as accurately as that of a star. If it is in rotation we may find periodic changes, provided that one side of it is lighter colored than another. The first instance of this kind to be detected is still the most remarkable. Iapetus, next to the outermost satellite of Saturn, is more than five times as bright when at its greatest apparent distance on the west side of the planet as it appears at the opposite point of its orbit, and maintains this difference year after year. It is clear that this satellite, like the moon, keeps the same face toward its primary. Seen from Saturn it would look queer, for the average reflecting power of the side which precedes in its orbital motion is less than one fifth that of the rear. Several other satellites show similar but smaller variations. Among the asteroids a dozen or more show definite periodic changes in brightness, and many more will probably be found by the time all the 1300 known planets have




**Top curve shows double wave in light from Ceres, with period of 3h 36 m. Curves *A* and *B* are for comparison stars, to eliminate errors. From an article by Dr. William A. Calder, in the *Bulletin of the Harvard College Observatory, No. 904***

been investigated. The periods are short —the longest so far recorded being less than ten hours and the shortest only two and one quarter. It may seem strange that these small bodies rotate faster than the great planets, but there is a good reason. A body of the low density of Jupiter or Saturn, if set rotating in two and one quarter hours, would fly to pieces—gravity would not be able to hold it against centrifugal force. But a mass as dense as the earth or even the moon would be stable. The asteroids are doubtless masses of rock, and hence dense enough to escape disruption. Moreover, for the smaller ones —less than 20 miles in diameter—the cohesive force of the rock—what an engineer would call its breaking stress—would hold it together more firmly than the feeble gravitation of so small a mass and afford a further safeguard. Slower rotations, in a day or more, may often exist—it is obvious that they would not be likely to be caught by a single night's observations which would infallibly detect a rapid change.

The brightest asteroids show but small changes. Dr. Calder, however, has recently found that Ceres varies by 3 percent in the very short period of 1h 48m. If the little planet is darker colored on one side than the other, this may be the rotation period; but it may be that it has two dark spots on opposite sides—or two bright ones—in which case the true period would be twice as long. It is not at all likely that two dark spots would be equally big and black or exactly opposite to one another. When a long series of accurate observations has been made, if the successive "waves" of the light curve turn out to be exactly similar, it will look likely that the shorter period is correct; but if alternate maxima and minima are unequal, the double period will be right.

The most remarkable variation of all is shown by Eros—perhaps the most famous of the asteroids anyway. In February, 1901, this showed the remarkable range of 1.2 magnitudes—three times as bright at maximum as at minimum—with two unequal waves, in the complete period of 5h 16m. Three months later there was hardly a perceptible change. This would be incredible were it not that the asteroid had moved into quite a different direction from the earth, so that we may well have been looking at it at first from nearly the direction of its equator and later of its pole. The large range in brightness would be hard to explain by the presence of bright spots on opposite sides. It is far more likely that Eros is irregular in shape—an elongated splinter of rock. It is so small that its gravitational attraction must be very weak and quite inadequate to pull it into a spherical shape against the rigidity of the rock of which it is composed.

IN February, 1931, Eros came within 16,000,000 miles of the earth. With the 26½-inch refractor at Johannesburg two experienced double-star observers, Van den Bos and Finsen, examined it carefully and on the first good night were rewarded by seeing a definite elongation of the tiny object—resembling a very close double star. Watching it from hour to hour they found that the angle of the long diameter shifted and completed a revolution in 5h 17m—just the period of the light variation!—proving beyond all question that this asteroid at least is of irregular shape. Had Eros been a double star, the distance between the two (slightly) overlapping images would have been 0."18 that night, corresponding to 14 miles at the planet's distance. In a rough way this may be taken to indicate that the planet is about 15 miles longer than it is broad.

It will unfortunately be many years before Eros comes so close again but at least the rotation of this one asteroid has been actually seen as well as inferred from its changes in brightness.—*Princeton University Observatory, November 4, 1936.*

# Movie Cartoons

By ANDREW R. BOONE

COLOR has reached greater perfection in movie cartoons than in real-life motion pictures. This is true not because of technical advances made by the cartoon manufacturers themselves, but because on their stage, which consists of a series of celluloid sheets containing paintings superimposed over a water-color background, they can control both lighting and action with machine-like precision.

The technique of applying color to cartoons, and the mechanics of photographing it, follow definite patterns which have removed the guesswork, characterized in earlier colored cartoons by great blotches which not only tired the eye but in some cases actually caused headaches—to both audiences and producers.

Color directors, who supervise the work of scores of artists in the larger cartoon studios, are charged with the task of providing colors which not only will harmonize, but also will enhance the action and mood of the picture. Action and characterization, as in the days when all cartoons were filmed in black and white, remain the most important of the several elements; but any color which makes those elements "difficult to read" on the screen impairs the beauty of the picture and destroys audience interest. Good color may be accepted without consciousness of its presence; poor color very largely destroys interest in the subject.

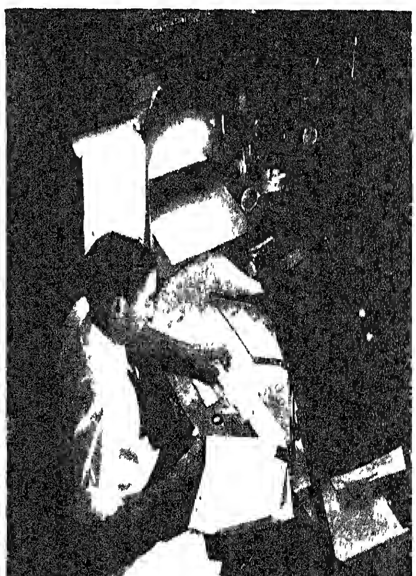
LET us consider color first as a "running story," and not as divided into artist's technique and camera mechanics. In the Walt Disney studio, for example, we find first a "gag-meeting" in progress. This consists of a luncheon which lasts all afternoon, and it is attended by an artist, among others. Here the story idea is organized. What animals shall appear? Are any to be "adapted" from real life? Possibly the color director suggests a character drawn from the rabbit. It is accepted, and a live rabbit is brought to the table for study.

Now, the cartoon artist proceeds on the theory that whereas a painting is easy to "read," colors of varying intensities when thrown in action on a screen often clash. Therefore, he attempts to keep the colors as simple as possible, and at the same time solid, in order to add weight to the characters. Backgrounds are designed not primarily for their pictorial beauty, but to aid the action by providing the proper color mood. To that extent backgrounds perform the same function as sets in feature productions.

In "The Country Cousin," a current release, we see how the color is selected for characters and background, and why. Here two mice (not Mickey) appear. Abner hails from the country, Mortimer from the city. The former wears light blue overalls, the latter black morning dress. Their bodies tend toward brown, for the natural gray of mice does not register well, has little "weight." The brown of the face and hands is warmer, thus accenting those features, as the action revolves around them. The country mouse is gay—therefore light blue clothes; his city relative is restrained and somber—therefore black.

In the background, contrasting shades support the characters—warmer if their clothing and skin are cool, darker if they are light. This applies both to light value and color. Contrast, readability, and solidness are the ends sought in order that the actors may move as a mass and not as spots of color. Now, cartoons do not generally pretend to offer live action. The characters are mainly stylized, and little attempt is made to make them look exactly like live animals. Again, therefore, the country mouse wears red pants, cool yellow shoes (not too potent lest the yellow distract from his facial expressions), and a light, warm face, the expression of which may be easily "read."

So, to get back to the early steps: The characters are first drawn in black and white and animated. After approval by the necessary department heads, the studio color director "sets" the colors in sketches which show all the various articles of clothing the individual characters will wear. Following this, tests are made to determine whether the colors will photograph as they have been visualized. Since 50 stage (background) settings may appear in a single picture, these obviously must harmonize with each other



Photograph, courtesy Walt Disney Studios

One of the camera set-ups used for recording on film the antics of movie cartoon characters

Cartoon animators studying the resemblance of a distorted human face to that of a rabbit. Thus they create the stylized characters that will amuse millions

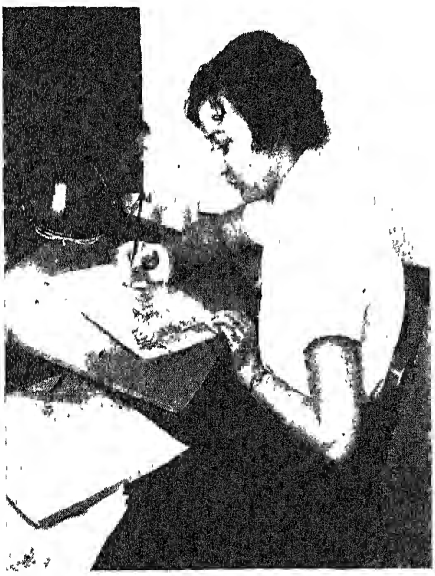
# In Color

## Enhance the Action . . . Simple, Solid Colors . . . Must Harmonize, Not Clash . . . Exposure Becomes a Problem . . . Constant Research a Necessity

and with the characters. These are painted after the color of the characters has been "set."

*In the next step, single-line drawings* are made. These are traced on sheets of celluloid in ink, and each open area receives a number which relates to a given color. That color may be one of a dozen shades of red, all of which have been tested to determine which one best expresses the idea of the sequence. *Following completion of the single-line* drawings, artists add the colors by number, building up the character mechanically bit by bit.

With backgrounds and drawings of the action on celluloid—called "cells"—completed, the "picture" is now ready to go before the color camera, which looks straight down on a large table, so fitted that the individual "cells" may be changed rapidly. The movie color cartoon camera is like others used for colored pictures. It has two cranks, one which will expose eight frames at one turn, another to expose a single frame. The cartoon cameraman uses the crank which will expose a single frame as it looks down on and through the celluloid drawings at the colored background. An air pressure device presses the celluloids into firm contact with the background painting, keeping all in focus.



Filling in colors on a "cell" in positions indicated by numbers, as explained in the text

In its simplest form, usually not less than four "cells" will be used. Suppose the mouse is to be photographed doing a bow on a stage. To show this, provided the entire figure is to move, the cameraman places the "cells" over the stage setting, with the figure "cell" second from the bottom. This is done for the reason that the exposure is calculated for the second "cell," no matter whether four or more are used. Thus uniform exposure is maintained on the principal character, while the other "cells" are either slightly overexposed or underexposed. However, only a technically trained critic could detect the difference.

To show the bow, the cameraman has available the background and a series *of pictures of the mouse on celluloid.* He places the picture of the stage on the table, and upon it lays a picture of the mouse standing erect, covering this with unpainted "cells." The mouse now appears to be standing on the stage. A single photo is taken, the celluloid painting is removed and replaced by a second painting showing him leaning slightly forward. This procedure continues for 24 frames, or 18 inches of film, to complete a simple bow.

IN a more complex scene, one involving two or more characters and properties, such as a tree, one or more paintings are provided on each of the four "cells." Five "cells" will be used for a crowd scene. On the bottom cell will be painted a property, particularly if it is to enter the action. While the main action usually will be confined to the second "cell," when several characters are present some will be painted on the third. To facilitate movements and save unnecessary painting, the body of a character may be painted on the second, its head and arms on the third. Darkened characters or props which can stand longer exposure without "burning" are placed on the fourth.

Mechanically, this process differs little from filming cartoons in black and white. Artistically, color opens a broad field of interpretation, for emphasis of situation. As in life, red denotes warmth, blue cold, a streak of yellow down a character's back fear or cowardice.

Constant experimentation goes on behind the closed doors of cartoon laboratories, for color, when it reaches the screen, does not always reproduce what the unaided eye has seen. You see a halo around a candle, but what colors will reproduce that scene for the screen? A character walks under the direct rays of a light. What tones will give the perfect illusion? Tests, an infinity of tests on short strips of film; tests involving thousands of colored drawings will provide the right answers. Only by this means do cartoons approach perfection in color, the greatest field which has yet been opened to them.

A typical story conference in a cartoon studio. On the wall is a complete series of rough sketches that tell the running story of a movie cartoon in the making

# Ourselves and the Feeble-Minded

By G. H. ESTABROOKS
Professor of Psychology at Colgate University

A FRIEND of mine adopted a child and in this case he "led with his chin"; so old Mother Nature passed him a jolt which has left him grouchy for ten years. Strange to say he was a doctor and should have known better. The little boy at the time of adoption was about three years old, an orphan from good farmer stock and the picture of health. He still is as husky a specimen as we could wish, but at the age of 13 he is in grade five, several years behind his proper place. Intellectually he is in the ranks of the feeble-minded—high grade feeble-minded, to be sure—but he has not and never will have normal intelligence. He may be able to complete grade seven by the age of 16 but he could never manage high school, and college would be absolutely out of the question. A child like this in a doctor's family, with its educational traditions, is nothing short of a tragedy.

And it was quite unnecessary. Ten years ago we had intelligence tests which could easily have spotted the condition. Today these have been even more refined and anyone who adopts a child without first checking up on its brain power is just asking for trouble.

You must not confuse the feeble-minded with the insane. Insanity could be detected in only a very limited number of cases at the age of three. But then, insanity is not generally inherited; it is the result of education and home conditions. If an adopted child should later develop a nervous breakdown, there is a strong probability that you are to blame. It would happen just as readily in the case of your own child. But the picture is quite different with the feeble-minded: either the condition is inherited or is present very shortly after birth. The insane, generally speaking, have a good brain and a normal intelligence up to a certain age. Then one of many things happens and they go "crazy." The feeble-minded just never did have normal brains to start with, even at birth. As a result, our intelligence tests can detect the condition as soon as it is well enough developed to measure—probably by the end of the first year, certainly by the fourth or fifth.

AND it's just bad news, for nothing can be done about it. The child can be placed in a home, can be trained to the limit of a very limited ability, in one type of case his intelligence can actually be raised, but a cure is hopeless; hopeless because intelligence depends on the brain, which in this case is not normal.

We divide the feeble-minded into two broad groups, the "hereditary" cases and the "clear sky" cases. The first are due to poor stock. Genius tends to beget genius, while the feeble-minded tend to have offspring which fall into their own class. Nor do the exceptions disprove this. You all know of cases wherein brilliant parents have stupid children; wherein genius springs from the slums. Away back in 1865 an Austrian monk by the name of Mendel outlined a law of heredity which still bears his name. We cannot explain that law here, for it is very complicated. Suffice it to say that it not only permits but even requires these curious exceptions.

Let us consider this hereditary group, since the problem here is relatively simple. First of all, how do we detect its members? This involves the famous intelligence test and the intelligence quotient. It consists of a series of problems so graded that the lowest are easy for a three-year-old, the highest may trip up a college graduate. For example, take the repetition of numbers. If I ask a boy of four to repeat after me the five digits 6, 4, 8, 1, 2, he cannot do it. The average child of ten can, and you as an adult should perform the task very easily. But if I raise the number to seven digits you will have trouble; and if I then ask you to repeat them backward, you will find it practically impossible. Should I ask you to define 80 out of 100 such words as "cat," "strike," "ready," you might feel almost insulted, but should I make the list contain words like "nematode," "polydactylism," and "shagreen" your indignation might be due to a totally different cause. A child of five is likely to give the wrong answer for such a simple problem as: "What should you do if you find your house on fire?" You can be just as easily stumped, but the task has to be on a somewhat higher level—consider the income tax return.

You can see from these very simple examples that it would be possible, given time and money, to draw up a series of intellectual tasks so graded in difficulty as to cover the entire range of human ability, from Einstein down—or up, if there is an "up." Then it would also be quite possible to find how high the average five-, ten-, or fifteen-year-old child could climb on the ladder. This would give us our yardstick. We could then measure you against this scale, no matter what your age, and say that you have the intellectual ability of a child of seven, fourteen, or of a genius. This we term your mental age (M.A.), which is quite distinct from your real or chronological age (C.A.).

We can now determine your intelligence quotient—I.Q. This we get from the formula $(\text{M.A.} \div \text{C.A.}) \times 100 = \text{I.Q.}$ Suppose your son is 10 years old but has a mental age of only seven. His I.Q. would be $(7 \div 10) \times 100 = 70$. This would place him in the "moron" group of the feeble-minded. On the other hand, a mental age of 17 would give, in this case, $(17 \div 10) \times 100 = 170$, or genius. One hundred is, of course, always the average I.Q. and we never allow the C.A. to go above 16, on the theory that mental development stops at that age.

SHOULD your I.Q. fall below 20 you would be styled an idiot, below 60 an imbecile, from here to 80 a moron; and above that normal, in various degrees of dullness or superiority. All this may sound complicated but actually a good "tester" can give a child the famous "Binet" test and classify him very accurately in an hour. This is the most time-consuming of all tests. We generally use a "group" test, wherein we take the children—or adults—in groups up to 100 or more at a time. This procedure is not quite as accurate as is the time-consuming, individual Binet, but yields very good results for all that.

That type of feeble-mindedness arising from poor heredity is society's greatest problem. Unfortunately it has not a great deal of interest for us at present. The picture is simple. Feeble-minded beget feeble-minded, the children of normal parents tend to be normal, while the offspring of genius tends to be well above the average of the race. Such exceptions as occur are easily explained by Mendel's Law.

However, almost half of the feeble-minded fall within the second group, the "clear sky" class, and this offers a totally different picture. If you, as a normal member of society, deliberately marry an individual who is feeble-minded, then your blood is on your own head. However, these clear sky cases arrive in all families, irrespective of parental intelligence, and offer a problem which medical science and psychology have not been able to solve. This great and unpredictable class divides itself into several smaller groups, all of great interest and all presenting

very special and interesting problems.

First we will consider the cretin. In the front of your neck, straddling the windpipe, is the thyroid gland. This is the great "pep" gland of the body and secretes a substance, thyroxine, which is absolutely essential to normal life. Its presence hastens metabolism—in other words, speeds up the engine. If in your case as an adult, the thyroid should suddenly cease to function, you would immediately lose most of your drive, start putting on weight, and in six months' time be a sad caricature of your present self—fat, lazy, and lacking all ambition. This occurs in some types of goiter. On the other hand, should this gland suddenly begin working overtime, as it does in the case of exopthalmic goiter, our picture is just the opposite: metabolism is accelerated to such an extent that the body literally burns up, using energy faster than it can be absorbed, so that the individual becomes very thin, nervous, highly excitable, and finally dies of exhaustion unless effective treatment is used.

IT sometimes happens that the thyroid gland is absent or defective at birth. We then get the cretin, a pathetic little idiot, fat, infantile, with a bronzed skin, little hair, and less brains. He seldom grows over five feet tall, the sex organs are quite undeveloped, he cannot talk, feed himself or learn ordinary habits of cleanliness—all through the absence of thyroxine, a condition which slows up the entire body development.

This particular kind of case does hold out a certain amount of hope. We can inject or feed thyroxine, prepared from the glands of sheep. This will to a certain extent replace the natural secretion and cause an improvement in the condition. The deficiency must be detected early and treated consistently, for any marked improvement. Even so, it is doubtful whether such a child ever becomes "normal" and a "cure" is never effected. The gland always remains defective—you merely supply the substance it secretes. You do not cure the disease in the sense of restoring the thyroid gland to health. Every institution for the feeble-minded has its quota of cretins who go through the regular course of thyroxine treatment. The fact that they are still there is mute testimony to the difficulty of obtaining any real improvement.

Another familiar figure in these institutions is the microcephalic or the "pinhead." As the name suggests, his main difficulty is one of shortage. There just isn't room in his tiny skull for normal brains. He usually rises to the level of the imbecile, can frequently do rough manual work and is a very good natured sort of individual who seldom offers problems of a disciplinary nature. The microcephalic presents an exasperating problem, in that we have not the least idea what causes this particular clear sky type. It simply arrives without the slightest excuse and leaves a problem against which we are helpless.

Somewhat different is the case of the macrocephalic or hydrocephalic, sometimes referred to as "water on the brain." The chief outward manifestation of this condition is too much head, and the cause seems to be somewhat the same as water on the knee. At an early age, sometimes before birth, and when the skull bones are still very soft, spinal fluid begins to collect in certain brain cavities. The pressure is sufficient to force out the brain and with it the skull, leaving the huge and often misshapen head of the hydrocephalic when these bones finally do harden.

Several diseases, such as meningitis, appear as a cause of this condition. Apparently they irritate the secreting membranes inside the brain, just as a blow on the knee may cause water. In the majority of cases we cannot locate the cause, as is also true with the knee, but it is probably due to a shock of some kind. A cure is pretty hopeless. Draw off the fluid and more promptly returns, as in the leg. Some cases are reported where brilliant and daring operations have effected a cure, but these are distinctly in the minority. Whatever the injury to intelligence—and it may range from practically nothing to complete idiocy—treatment is very unsatisfactory. We can only hope that the great advances made in brain surgery may some day find a cure for this condition.

Mongolian idiocy is a fourth well recognized type of clear sky case. The child looks somewhat like a little Chinese. Yellow skin, slant eyes, straight hair, round head, and short limbs yield a caricature of the mongol. The sufferer always remains a dwarf, is quite unable to read, write, or take care of himself, and sexually is altogether undeveloped. We haven't the slightest idea what causes the condition, and can do nothing whatsoever to effect a cure. Just one of many cases wherein science has made little progress.

BIRTH injury is now recognized as another cause of feeble-mindedness. A baby's skull is very soft and the brain, even if well protected, is a sensitive organ. The bones of the head have not united at birth but can be moved separately. Under these circumstances a very difficult delivery, especially if instruments have to be used, may easily result in brain injury. This seems especially true in cases of premature birth or where the baby is very small. Apparently the skull gives even less protection to the brain in these cases. The effects of birth injury are largely what one would suspect, depending, as they do, entirely on the area affected. They run through all the grades of feeble-mindedness, but include as well certain paralyses and even emotional upsets resembling insanity which are due instead to injury in certain areas. Treatment of these cases is extremely difficult, almost hopeless. A great deal of research is being devoted to these birth injuries and perhaps the future will give better news.

The above five groups are generally accepted as representing the clear sky cases of the feeble-minded. There may be other minor classes beside. For instance, certain research leads to the suspicion that an excessive use of X rays before birth may have very bad results on the child's mentality. Be this as it may, we can say roughly that about half the feeble-minded are due to "poor stock" and the other half to these unpredictable cases.

We cannot discuss the broader social implications involved in this situation, owing to lack of space. Just what does it mean, however, to you as an individual? We have a saying in college that all problems should be settled in the Admission's Office. In theory, a director of admissions could choose a freshman class which would be ideal and never cause any trouble. Actually, of course, he can't, but he can do a lot.

So with you. The admissions office is the marriage altar. If you choose a partner of inferior mentality or one from a highly neurotic stock, you are more or less "asking for it." On the other hand, if this partner is the equal of yourself, you have taken every reasonable precaution and are safe within very broad limits. But only within these broad limits. We can offer absolutely no guarantee that you will not be saddled with one of the clear sky cases, no matter how good your stock and that of your partner. After its arrival you must face the further fact that medical science can do practically nothing to relieve the condition. All of which may seem pretty discouraging, but it is the picture as it exists today.

WE can, however, offer very definite service on the matter of adoption. A good child psychologist can spot the graver cases of feeble-mindedness by the end of the first year. At three years he is more accurate, and at five he can almost predict the college grades. Make no mistake in this matter of adoption, for it can result in tragedy. A child of three looks very "cute," is healthy, and talks a blue streak. So—what the devil! —everyone knows that mental tests are bunk, and you want him very badly.

But take it easy. If your family has a good educational tradition, and if that child happens to be sub-normal—a condition which you yourself might easily overlook—the future won't be too happy for either of you.

# INDIUM—A METAL ARISTOCRAT

By SIDNEY J. FRENCH
Assistant Professor of Chemistry, Colgate University

THE scene is Paris, the right bank. The time is Spring, 1940. The young man's fancy, irrevocably bound to love, now turns to jewelry. He would buy the lustrous pendant reposing in the modernistic window before him. He steps inside. The pendant is presented for his inspection. "Are you sure," he asks, "that this is white gold?" "Ah, no, Monsieur," replies the clerk, "that is not white gold. It is the newest thing in precious metals, indium. Fortunately we can sell it to you at a lower price than white gold. But if you prefer, we can give you the same thing in a gold setting." But the latest mode and price are indeed desirable to this young man. "I'll take it," he says quickly, and turns over the proper number of francs. Cheated? No! For the clerk who sold the pendant, the man who bought it, and the girl who received it so happily, none of them could guess that he or she would live to see indium become one of the most popular of the aristocratic metals.

Had this young man attempted to find an indium pendant in 1930 his search would have proved fruitless, for there were no indium pendants. There was, in fact, so little of the metal available that he would have paid 270 dollars for an ounce of the almost unknown metal. In 1936 he could buy it for less than 30 dollars an ounce, with gold quoted at 35 dollars an ounce. In 1940, what? Just what is the future of this remarkable metal which has risen like a new star to join the galaxy of semi-precious metals? What can be done with a metal softer than lead, lighter than zinc, more lustrous than silver and as untarnishable as gold? What can be done with a metal which melts at a lower temperature than tin? These questions confront science and industry at the present moment when indium, from a mere name and number on a table of atomic weights, becomes a tangible, useful, and desirable metal. Today, exploitation and experimentation; tomorrow, sales promotion and advertising. Today, the laboratory; tomorrow, the market. This is the course of all new materials. This is the path indium must follow.

THE future of any new material may be divided into two parts, the predictable and the unpredictable. Accidental discoveries not now foreseen constitute the unpredictable. The predictable future is determined by facts already known. The known facts lead to the inevitable conclusion that indium will play an important rôle as a metal of luxury for it has all the qualifications of such a metal. Used alone, it is unsuitable for jewelry, for, like gold, it is very soft; but alloyed with small amounts of silver or copper it gives a hard, durable, lustrous surface which remains undimmed in air. It alloys

William S. Murray, President, The Indium Corporation of America, with over 200 ounces of indium

equally well with many other metals including gold, tin, cadmium, lead, and zinc. To each of its alloys it lends its durable properties of non-corrosion. Already patents exist covering precious metal alloys containing gold, palladium, silver, copper, and indium for use in dental castings and jewelry and covering alloys of silver and indium.

In addition to its use in the form of alloys, indium can also be plated on suitable metal surfaces. When first plated, the surface coating is soft and dull. If the plated object is heated, however, the indium, because of its low melting point, sinks into the underlying metal, giving a durable surface alloy which will take a high polish. This high luster and durability of a silver-indium surface alloy has found unique application in reflectors to increase reflecting power and lengthen the life of the reflector. In dental amalgams, indium is being used with silver and to replace silver.

Other almost unique uses of indium depend on the very low melting point of the metal. The fact has been known for a long time that when two appropriate metals are melted together an alloy may be found which melts at a lower temperature than either metal taken alone. The addition of a third and even a fourth metal may depress the melting point still farther. In this manner, bismuth, lead, tin, and cadmium, all low melting metals, form an alloy which melts below the boiling point of water. It occurred to the writer a short time ago that the addition of indium to these four common metals should produce an alloy melting at a very low temperature. In practice, it was found that the addition of indium produced an alloy melting far below the boiling point of water. In fact, the alloy melted at 116 degrees, Fahrenheit, not far above normal body temperature. This liquid alloy may be brought into direct contact with the body and allowed to harden in place without discomfort.

THIS alloy may therefore well find uses in art for taking impressions of the features of living persons in place of the more unwieldy and slow hardening plaster of Paris. For example, a finger or foot may be partially immersed in the molten alloy. The alloy is then chilled to promote rapid setting, thus greatly reducing the time required for immersion and permitting the formation of a faithful impression. Impressions of the feet and hands of artists could be obtained for posterity with a high degree of perfection. Three-dimensional finger prints or foot prints might have decided advantages over the present ink and paper prints used in the detection of criminals.

But the objection may well be raised that such molds would be both costly and perishable, since the alloy is expensive and slight accidental heating would melt the mold. Such objections are easily answered, for the alloy mold need not constitute a permanent mold. It is merely placed in a suitable plating bath and plated to the desired thickness with copper, silver, or other metal. The plated mold is then placed in hot water, whereupon the alloy melts off, leaving a cast of durable, inexpensive metal. The alloy is thus recovered for further use.

Since the alloy has such a low melting point, it may also find possible use as a spraying metal to cover objects of art. The molten metal is sprayed under pres-

## Softer than Lead, More Lustrous than Silver, as Untarnishable as Gold . . . Has Risen Like a New Star in the Galaxy of Semi-Precious Metals

sure over a plaster or wooden object to form a continuous metallic coating. If desired, then, other metal may be plated over the alloy or the object may be gently warmed to give a smoother finish.

Still another possibility which presents itself in the field of art is the use of such an alloy for etching. Lines and figures can be engraved in the alloy surface with an electrically warmed pen. The softened parts of the metal may then be worked by the artist as desired with bare hands to build up figures in relief. The object may then be plated, the alloy melted out and the mold thus obtained used for making permanent casts.

The fact that such alloys can be molded by hand should make possible the building up of objects of art, much as a sculptor builds up a clay statue. Mistakes might be erased by the application of heat. From such models, permanent casts could be made by plating.

For making seamless hollow vessels of odd shape, such low-melting alloys can be poured into a suitable cast, the cast removed and the remaining mold or core of alloy plated with cheaper metal; the plated mold is then warmed up and the alloy poured out through a small opening.

ANOTHER suggested use of such an alloy is in surgery. The alloy, impregnated in cloth or some other soft matrix and heated above 116 degrees, Fahrenheit, becomes soft and pliable. This is placed around a fractured or broken limb while the surgeon manipulates the bones into place. The cast is then cooled in position and sets to a rigid condition holding the broken members in place. When it is desired to remove the cast, hot water bottles are applied and the whole again becomes pliable. There is no pulling, breaking, tearing, or chipping of plaster or plaster impregnated cloth. There is likewise no pain for the patient.

Finally, such low melting alloys may find use for controlling temperatures, and for automatic fire alarms and control systems.

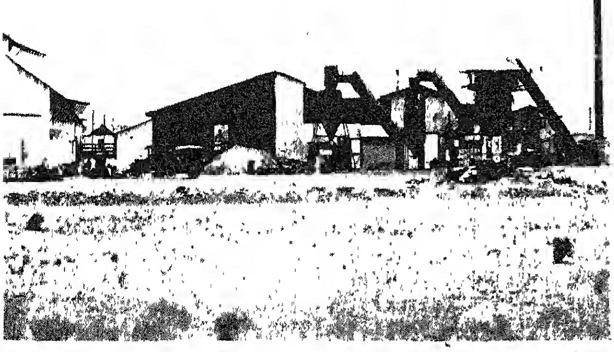
If the present is any indication of the future, indium is on its way upward in use and downward in price. Still, nature has sprinkled this aristocratic metal but lightly over the surface of the earth and it must therefore ever remain a member of the semi-precious caste. As metals go, it is young, for it is not yet a century old. It may be interesting, now that the present has been unfolded and the future predicted, to turn to the past; for indium has had an interesting history.

In 1863, Ferdinand Reich was studying some ores with his spectroscope. He was looking for the metal thallium, which should write its spectrum signature with a prominent green line. But he couldn't find the green line. He saw the lines of zinc and lead in his ore but none for thallium. But what was that very prominent line near the violet end of the spectrum? He rubbed his eyes and looked again. Could it be potassium? Impossible. He got out his references and checked. No known element had that particular signature. But he wasn't certain, because he was color-blind and had to rely on the position of the line instead of the color. So he called in his assistant, Theodore Richter. Richter saw the line too, and he saw another fainter line. Unquestionably they were the lines of a new element begging to enter the world of known elements.

No name could be more appropriate than indium for this element which wrote its signature with such a bold *indigo* line. So, *indium* it became. Then started the laborious and time-consuming task of getting some of the new element out of the ore. They precipitated, dissolved, roasted, purified, and plated. Months later they were rewarded with a small sample of the pure metal. And what a metal! In 1867, Richter exhibited two samples of the new metal to the French Academy of Sciences. Each sample was about the size of a lead pencil and Richter placed a value of 40,000 dollars on them. But indium did not come into fame overnight. Who could play with a metal worth 20,000 dollars an ounce?

More than 50 years passed and indium remained but a name, a number, and a blue line. Few museums could boast of a sample. The price fell, however, for in 1924 indium was valued at 300 dollars an ounce—merely a paper value, for there wasn't an ounce available from a supply house in the whole world. When Mr. William Murray, of Utica, New York, attempted to purchase 10 grams (⅓ of an ounce) of the metal for experimental uses in 1924 he couldn't find 10 grams. Finally he got one gram from Germany, at a price of ten dollars. Within ten years of that date, however, he was able to display more indium than had been produced altogether in the 50 preceding years. He had a total of more than 250 ounces of the interesting metal. Valued at the price of 1864 it was worth more than 4,000,000 dollars, at the 1924 price, 100,000 dollars and the 1934 price, less than 7000 dollars. Moreover, it was not a paper price, for the 250 ounces were there in his laboratory for anyone to purchase. In 70 years, the price of indium had fallen 1000 fold.

FOR three quarters of a century indium has been a curiosity for scientists to play with. It has been but a name and a number among the 92 elements. No longer, however, is it merely "Element number 49," writing its signature with a blue spectrum line. It is a metal, available and desirable. It is here to stay. Its future is in the lap of the gods and the hands of keen-sighted industry. Tomorrow we may awake to find ourselves indebted to this metal for safety, comfort, pleasure, and luxury. Tomorrow the word indium may be as common to our vocabulary as the word chromium is today. And so, another member will have been added to the ever growing society of metal aristocrats.

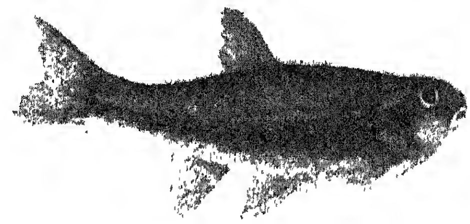


**Indium recovery plant in Arizona. The building at the extreme left houses the refining equipment, the central one a rotary furnace. To right, dust collectors**

# Fish and Physicians

## A Fish that has Flopped into One of the Biggest Scientific Ponds of the World—Cancer Research ... Some very Important Revelations Have Resulted

By HARRY PELHAM ROBBINS
President, Memorial Hospital for the Treatment of Cancer and Allied Diseases



The rosy-sided dace. This small fish proved to be the much-sought-after subject of experiments on the cause of cancer

FISH and physicians work together today in seeking the cause and cure of cancer. One reason why fish are helpful in the unremitting quest for the control of cancer, which still ranks second in the list of causes of death, is that they themselves are subject to cancer. Their use in various reactions and experiments has come to play an important rôle in study of the disease.

When Memorial Hospital was founded in New York City 52 years ago, for the treatment of cancer and allied diseases, it is certainly likely that the founders, far-seeing though they were, had not the slightest idea that fish would some day play a part in its history. They were thinking more of surgery, nursing, and opiates. But the story of study and treatment of cancer in this and other institutions is not complete without reference to the contribution which fish have made to advancing knowledge and effective treatment. The record includes the saga of a poor fish which has become very valuable. This humble and obscure member of the piscatorial family has emerged as a sort of Cinderella in Science Land, and become much sought after. The recent discovery of this small American fish, the rosy-sided dace—or to use its scientific name, *Leuciscus vandoisulus*—which may serve as a diagnostic test for a malignant form of human cancer known as melanoma, directs attention to the many services which fish have rendered in the field of cancer. But we are getting ahead of our story of the poor fish which has become a very important fish.

The trout family, too, are playing their part. About 1904, epidemics of thyroid cancer in artificially bred trout nearly ruined the trout breeding industry in several localities here and abroad. The thyroid gland in fish consists of many islets of gland tissue scattered about the gills and throat. The cancer caused a rapid enlargement of all these islets, so that the fish choked to death or died from ulceration of the enlarged glandules. At first it was thought that the disease was of infectious nature, and the late Dr. Harvey Gaylord endeavored to prove this origin by elaborate experiments conducted at the fish farm of the Buffalo State Institution for Cancer. However, the conclusion was reached that the cause was really overfeeding of the young trout with a badly balanced diet and in the general chemical pollution of the waters. With the fish in well watered streams and on a correct diet, the disease was eradicated. Yet thyroid cancer still occasionally appears in sporadic cases in several kinds of fish.

About this same time zoologists began to notice the occurrence of various kinds of cancer in fish. In 1904 Marianne Plehn, of Munich, recorded several cases of cancer of the skin, bones, and internal organs of fish which she studied in Germany. After that, reports of cancer in fish became more numerous as attention was called to the matter, and it soon became apparent that, while cancer is comparatively rare in fish, it may affect almost any variety, and under almost any conditions. In 1933 Alexander Haddow and Isobel Blake, of the Scottish Fishery Board, collected from the literature about 50 different types of tumors which had been observed in as many different kinds of fish.

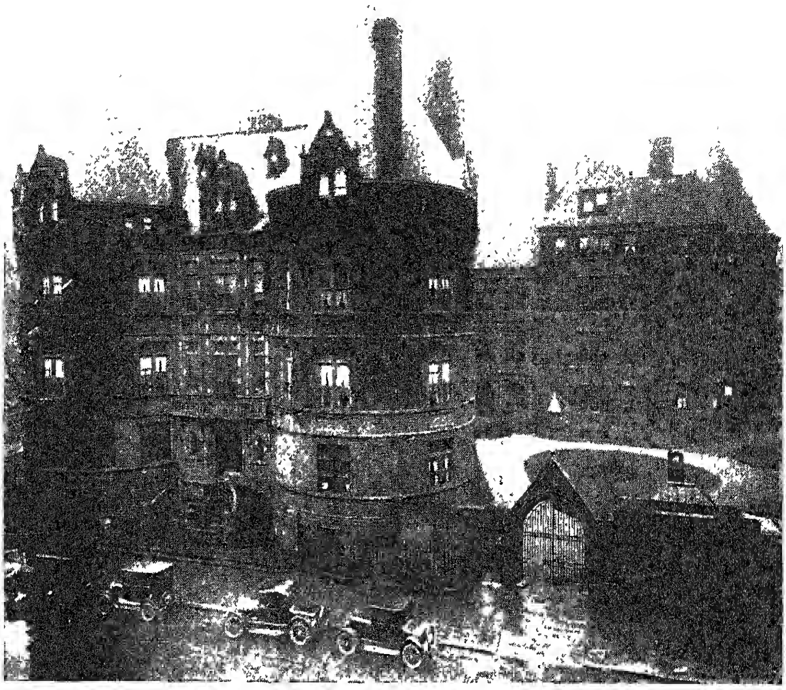
HERE we also introduce frogs as co-workers with fish and physicians. In fish and frogs, as in man, the growth and functions of the organs are largely under the control of the glands of internal secretion. One of these glands, the thymus gland, which lies just above the heart, stimulates the growth of youthful or embryonal cells. When ordinary tadpoles are fed on thymus they soon develop into giant tadpoles.

Another of these glands is the thyroid, which tends to restrain growth but to make it more adult in type. This fact was discovered by Dr. J. F. Gudernatsch, working as a member of the Memorial Hospital staff, when that work was being conducted partly at Cornell University Medical College. It came about in this way: Between 1880 and 1890, thyroid extract was sometimes used in the treatment of cancer, and occasionally good results were reported. The Memorial Hospital staff observed some of the apparently good results and decided to investigate the reasons, if any existed. To make a long story short, Dr. Gudernatsch's crucial experiment consisted of adding a minute quantity of thyroid extract to a small aquarium containing tadpoles. He found that the tadpoles were transformed into frogs almost over night. This experiment demonstrated the differentiating action of thyroid extract which causes young cells to hurry up and become adult cells, but at the same time restraining growth. In this way the restraining action of thyroid extract on cancer cells was explained. Unfortunately, however, this action is not strong enough to render thyroid extract an effective agent in the treatment of cancer.

Now enter radium and X rays to join the fish, frogs, and scientists. Among the major problems of cancer research is the mode of action of radium and X rays, of which comparatively little is yet definitely known. Yet these agents are a very important means of curing cancer in its early stages. Fish eggs are very susceptible to X rays and radium rays and the effects are easily traced in these simple structures. Many investigators have subjected the eggs of various varieties of fish to different forms of radiation and have determined what effects follow. In this way many curious and important

variations have been discovered in the behavior of the eggs at successive stages of development. Some are radio-sensitive and others radio-resistant. These experiments have shed considerable light on the mode of action of the rays and on the factors making cancers susceptible to radiation.

They have also demonstrated some of the adverse effects of radiation. Dr. C. R. Stockard found that chemical injury of eggs, or young embryos, sometimes leads to the production of one-eyed monsters by injuring the delicate mechanism of the embryo eye so that, while the fish might grow up to normal size, it would have only the one eye of the cyclops. In 1925 Dr. Hinrichs, of the University of Chicago, noted the formation of monsters in Fundulus fish following exposure to ultra-violet rays.



Memorial Hospital in New York—its complete name being "Memorial Hospital for the Treatment of Cancer and Allied Diseases." First institution of its kind in America

Dr. Oppermann, of Germany, in 1913 studied the effects of radium treatment on the sperm and the fertilized egg of the trout. He noted head, eye, and tail defects as a result of the treatment. In America, Dr. Charles R. Bardeen, of the University of Wisconsin, was the first to show that fish eggs fertilized by radiated sperm developed various types of deformities in the fish hatched from such eggs.

IN 1906 Dr. Tur, of France, studied the action of radium upon the embryos of the common dogfish. The embryos that developed were smaller than the normal and were markedly defective, having practically no central nervous system. Dr. Bohn, of France, in 1903, and Dr. Schaper, of Germany, in 1904, used radium on the young of frogs, toads, and newts. In 1913 Dr. Hertwig repeated the work with frogs' eggs and radium-treated sperm cells. All these investigators noted faulty development of the skin, blood, and nervous systems which varied with the amount and duration of exposure.

Warned by the results of these studies, physicians now use proper precautions when employing X rays or radium in the case of pregnant women, especially in the early months of gestation. Yet many women have borne healthy children after having been cured of tumors of the pelvic organs by radiation treatment.

Funny family, the fish! They live mostly at low temperatures, so the processes of digestion and assimilation of food and the growth of cells lack the stimulus of the heat which higher animals enjoy. Hence the organs of fish contain large quantities of growth-stimulating substances, ferments, and vitamins, on which growth and energy depend. It is the presence of these agents, especially vitamins, to which cod-liver oil owes its medicinal value, effectiveness in preventing rickets and in stimulating general nutrition. Furthermore, cod-liver oil used in the prevention and cure of rickets probably also reduces the tendency to some forms of tumor growth, especially those affecting the bones.

**THE accompanying article has to do with research on cancer conducted at Memorial Hospital in New York City, the first special institution of its kind in the United States. Last year it maintained 110 beds and accepted 3200 patients for treatment. A daily average of 325 patients come to its clinics. About one third of the work is free.**

**Last year the Hospital received a gift of 3,000,000 dollars from the General Education Board, founded by John D. Rockefeller, Sr., to build a new home in New York, and the new structure is to rise near the Cornell University Medical College (with which the Hospital is affiliated) and the Rockefeller Institute for Medical Research. Dr. James Ewing is president of the Hospital's medical board.— *The Editor.***

But here is where the real color comes into the story of the unknown fish. Most fish and batrachians (frogs and toads) are highly pigmented; that is, are characterized by a wide variety of deposits of pigment which protect them against their enemies and against the effects of sunlight. In fact, pigmentation is a more important function and more elaborately developed in these animals than in any other species, except the insects.

Some very important revelations regarding the control of the function of pigmentation, both in lower animals and in man, have resulted from experiments on fish. These experiments center about the influence of the pituitary gland on the behavior of pigmentation. The pituitary gland is an organ of internal secretion which presides over many functions of the body, including growth of tissues, sex characteristics, and especially pigmentation. It is the central signal tower of the system of glands of internal secretion. It acts mainly by stimulating other glands according to their needs. It is located in a protected bony recess in the base of the skull.

THE first indication that the pituitary gland had anything to do with pigmentation was obtained by Dr. Evans and Dr. Smith of California. They removed the gland in tadpoles, which are pigmented, and found to their astonishment that these tadpoles lost their color and became silvery. Indeed, they were albinos—almost free from pigment. They could not produce pigment when deprived of the pituitary gland.

The next important observation was long delayed. In 1932 Dr. Bernhard Zondek in Berlin isolated from the middle lobe of the pituitary gland a special secretion or hormone which had a remarkable action on the pigmented skins of

Quiet but systematic activities in the Biophysics Laboratory, Memorial Hospital

many fish, and which he called "intermedin." Many agents cause a similar effect on pigmented fish, but after many trials Dr. Zondek found a fish, commonly known in Germany as the *Elritze (phoxinus)*, which apparently reacts alone to intermedin and is therefore a test for this hormone.

When a minute amount of intermedin is injected into an *Elritze*, the black spots on the back become shrunken and darker, while brilliant red spots soon appear about the ventral fins. This sharp change in color is very similar to that which occurs naturally during the breeding season, and the reaction to intermedin is not so sharp during the breeding season.

BUT what have white frogs and red *Elritze* to do with cancer? This question remained to be answered by one of the workers in the laboratories of the Memorial Hospital, where many cases of a fatal form of pigmented cancer are seen. This worker concluded that, if intermedin has such a remarkable influence on pigment cells in fish and frogs, it might be found active in a malignant tumor composed of these pigmented cells in a human being, and therefore might be present in excess in the tissue of pigmented cancers and probably also in the blood and urine of such patients. After observing many such cases, he proved that precisely such conditions do exist. He found varying quantities of intermedin in tumor tissue, in the blood and in the urine, as well as in some other tissues. Using certain precautions, he was able to show that the test for intermedin in the German fish *Elritze* was of value in the diagnosis of pigmented cancer.

But the *Elritze* is found only in Germany. Its importation to the United States, alive for experimental purposes, offered many difficulties and was expensive. It became highly desirable to find some American fish which would serve the same purpose. So the inquisitive doctor consulted New York fish dealers, showing them an *Elritze*. They had never seen such a fish. He was greatly aided by the experts at the New York Aquarium, who told him that a very similar fish could be found in Maryland. The physician laid aside his microscope and white coat, packed his grip, bought a pair of rubber boots and headed for Maryland. Wading the stream in hip boots, he finally discovered the fish. It was the rosy-sided dace *(Leuciscus vandoisulus)*, the American cousin of the German *Elritze*.

Experiments with this fish at Memorial Hospital proved that it reacted as did its German cousin. So far as known, it is the only American fish which does so react, and thus far it has not reacted to any agent except intermedin. It has been found in several small southern streams.

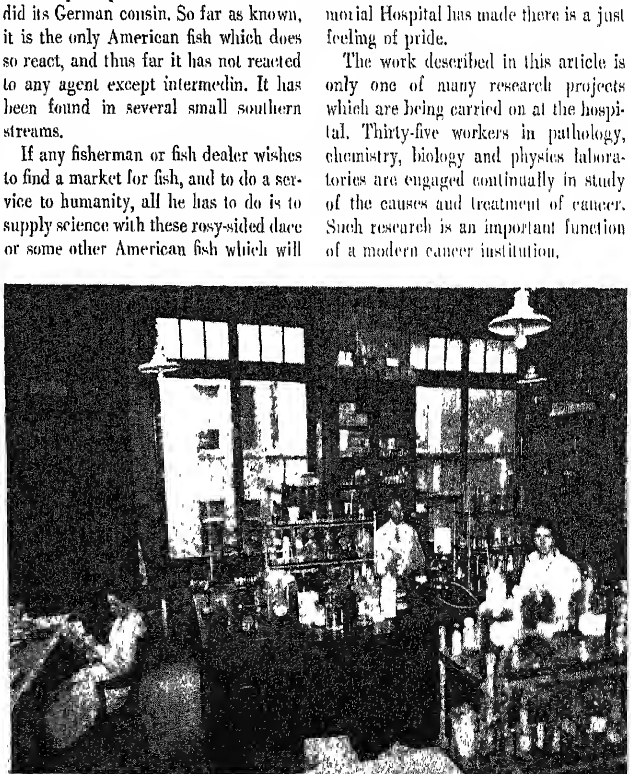
If any fisherman or fish dealer wishes to find a market for fish, and to do a service to humanity, all he has to do is to supply science with these rosy-sided dace or some other American fish which will react only to intermedin. This fish, unknown and hitherto quite unimportant to the fish world, has flopped out of the little pond of obscurity into one of the biggest scientific ponds in the world — cancer research.

There is a lot more yet for the doctors and the rosy-sided dace to demonstrate about cancer. That intermedin actually figures in the origin and growth of pigmented cancer remains to be shown, but experiments already conducted show that intermedin increases the growth of a pigmented cancer in a mouse about 50 percent. Certain small fish themselves suffer from a fatal form of pigmented disease known as melanosis. Dr. Myron Gordon of Cornell University has been studying this disease for some years and has demonstrated many of its peculiar features, including quite pronounced Mendelian hereditary characteristics.

IT IS not unreasonable to expect additional revelations regarding pigmentation and diseases involving it, and that fish may be employed in numerous other relations to increase the *present knowledge* of cancer.

The pleasant task of telling in a somewhat popular vein the story of a very worthwhile achievement has fallen to a layman, *but without that tireless perseverance* of medical and research workers, carried on with the spirit which is so characteristic of those engaged in the cancer field, this story could not have been told. For such contribution as Memorial Hospital has made there is a just feeling of pride.

The work described in this article is only one of many research projects which are being carried on at the hospital. Thirty-five workers in pathology, chemistry, biology and physics laboratories are engaged continually in study of the causes and treatment of cancer. Such research is an important function of a modern cancer institution.



The chemistry laboratory at Memorial Hospital, where basic research is

| | CAPITAL SHIPS | AIRCRAFT CARRIERS | CRUISERS-A | CRUISERS-B | DESTROYERS | SUB-MARINES |
|---|---|---|---|---|---|---|
| UNITED STATES | 15 SHIPS - 464,300 TONS | 7 - 146,500 | 19 - 179,150 | 19 - 160,000 | (34,065 TONS ADDITIONAL PERMITTED)<br>244 - 306,875 | (10,445 TONS ADD'T'L PERMITTED)<br>104 - 99,015 |
| GREAT BRITAIN | 17 SHIPS - 340,750 TONS | 9 - 171,450 | 19 - 183,396 | 54 - 320,040 | 216 - 280,829 | 69 - 73,000 |
| JAPAN | 9 SHIPS - 272,000 TONS | 6 - 80,470 | 14 - 123,520 | 26 - 144,325 | (1,500 TONS ADDITIONAL PERMITTED)<br>122 - 151,270 | (528 TONS ADD'T'L PERMITTED)<br>70 - 86,049 |
| FRANCE | (52,000 TONS ADDITIONAL PERMITTED)<br>13 SHIPS - 308,925 TONS | (37,854 TONS ADDITIONAL PERMITTED)<br>1 - 22,146 | BUILDING IN THESE CATEGORIES NOT LIMITED<br>10 - 105,923 | 13 - 89,225 | 91 - 142,520 | 83 - 83,811 |
| ITALY | (105,000 TONS ADDITIONAL PERMITTED)<br>6 SHIPS - 156,532 TONS | NONE BUILT OR APPROPRIATED FOR 60,000 TONS PERMITTED | BUILDING IN THESE CATEGORIES NOT LIMITED<br>10 - 94,291 | 19 - 93,722 | 110 - 110,944 | 84 - 60,720 |
| GERMANY | BY AGREEMENT WITH THE BRITISH EMPIRE - LIMITED TO 35% OF AGGREGATE TONNAGE OF ALL NAVAL SHIPS OF THE BRITISH EMPIRE<br>8 SHIPS - 121,120 TONS | 2 TO BE BUILT TONNAGE UNKNOWN | 2 - 20,000 | 7 - 42,900 | 35 40,438 | 36 - 15,500 |

# STATUS OF WORLD NAVIES

## Recapitulation of Treaty Navies as Washington Naval Limitation Treaty Expires December 31, 1936

GERMANY is the newcomer in this review of ships and tonnages of world naval powers. Since the Versailles Treaty limited her navy so rigidly, she was not even considered in the Washington Treaty of 1921, nor in the London Treaty of 1930, which imposed limitations on naval construction among the other five nations shown above. By reason of her abrogation of parts of the Versailles Treaty and her subsequent agreement with the British Empire, as noted on the drawing, her naval status once more is of concern.

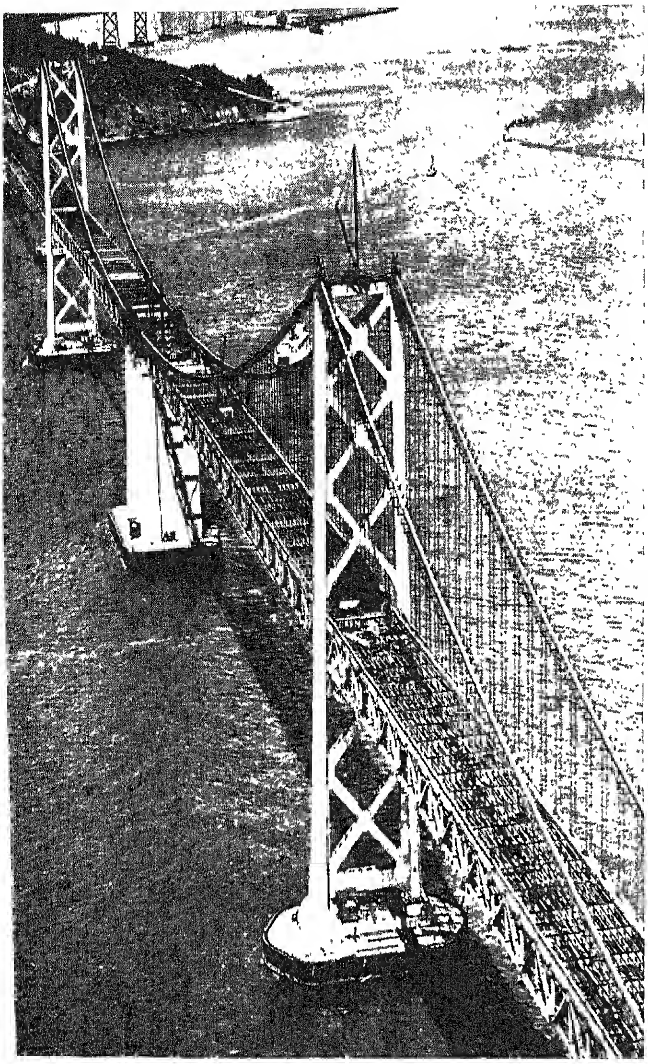
As the Washington Treaty expires, some feel that the future of naval limitations is but a forlorn hope, though others—for example, Admiral Standley of our navy—are more optimistic. Yet naval limitations has a history of several failures. In 1921, capital ships and aircraft carriers were limited by the United States, Great Britain, Japan, France, and Italy. The Geneva Conference of 1927, attempting to impose limitations on smaller ships, was a complete failure; while the London Conference of 1930 limited cruisers, destroyers, and submarines for the United States, Great Britain, and Japan. The United States "leaned over backward" in observing these treaties, but our disarmament by example did not work.

In December, 1934, Japan announced her intention to terminate the Washington agreement at its expiration December, 1936.

Japan demands parity with Great Britain, Germany becomes a factor in naval questions, France builds ships to offset Germany's rising strength, Italy feels that she has a greater responsibility in the Mediterranean and has started an active naval building program. The United States has indicated her intention to build if others do.

Both Japan and Great Britain are discussing construction of battleships, though in all fairness, it must be noted that the figures indicated in the column above for Great Britain include tonnages for capital ships, cruisers (B), destroyers, and submarines that were not laid down before expiration of the Treaty. Great Britain will also dispose of four of her 19 cruisers (A), three to be converted into cruisers (B). It should be noted further that there is included above obsolete tonnage (as of December 1935) in the following approximate amounts: United States, 320,000; British Empire, 327,000; Japan, 200,000; France, 200,000; Italy, 137,000; and Germany, 34,000.

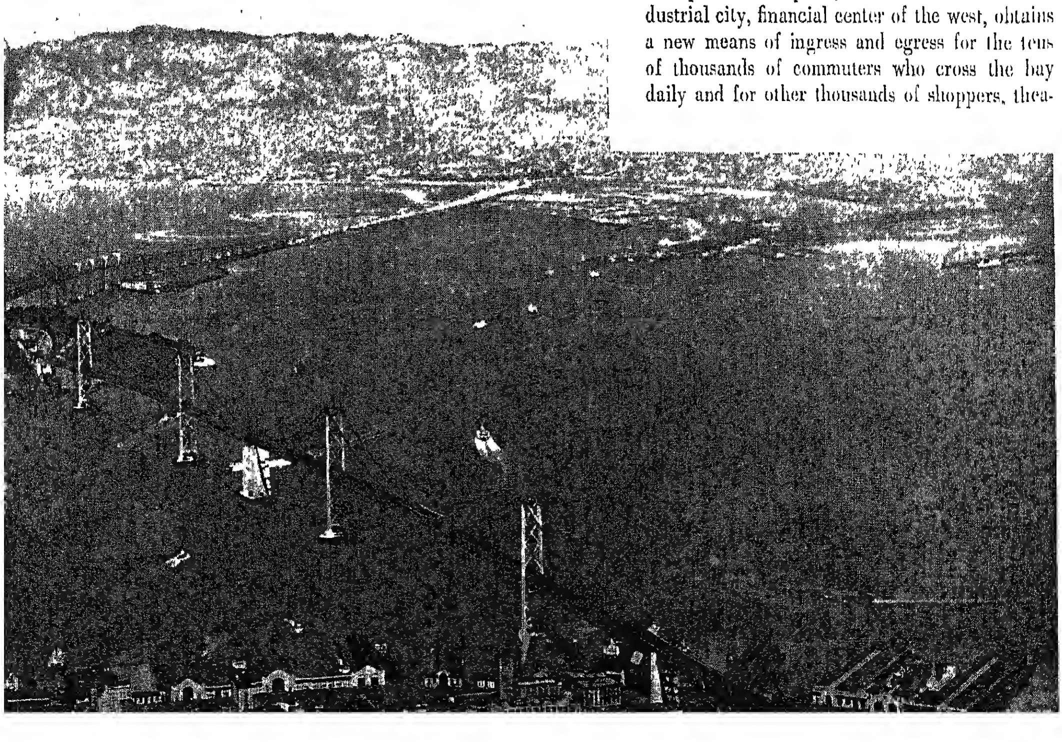
*—F. D. McHugh.*



wo views, above and below, of the San Francisco-Oakland Bay Bridge were 'aken from the San Francisco end, but from different angles. They show the ure nearing completion just prior to the opening. In the photograph below e seen, at the lower right, the main approach and the "on" and "off" ramps

# WORLD'S LONGEST BRIDGE NOW OPEN

MOTORISTS now may drive from Atlantic City, New Jersey, directly into San Francisco, California, without leaving the Lincoln Highway (U.S. 40). This is possible with completion of the 9.1-mile San Francisco-Oakland Bay Bridge, dedicated November 12 when a horse was ridden across the structure from Oakland to San Francisco in violation of state laws. To appreciate the immensity of the project, which was commenced in May, 1933, one must understand that the bridge unites San Francisco County on the west with Alameda County on the east, thus providing speedier transportation across San Francisco Bay for 1,221,000 persons of these political groups, and uniting also the residents of nearby San Mateo (on the west), Marin, and Contra Costa Counties (north and east). On the east side of the bay the cities of Oakland, Berkeley (home of the University of California), Albany, Emeryville, and Piedmont are directly affected by the project. Thus San Francisco, second largest United States seaport in imports and exports, seventh United States industrial city, financial center of the west, obtains a new means of ingress and egress for the tens of thousands of commuters who cross the bay daily and for other thousands of shoppers, thea-



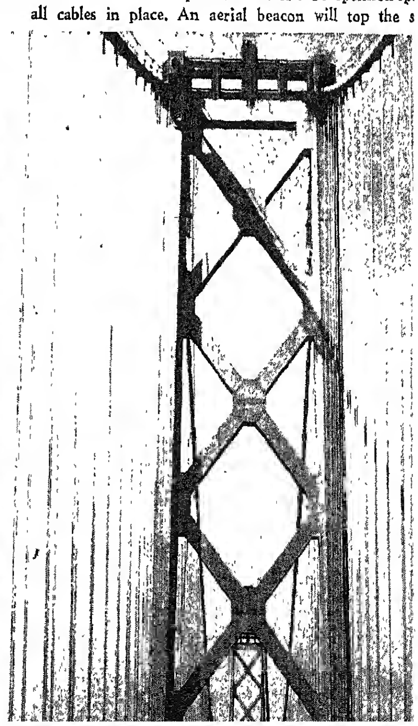
## Only Four Years Building . . . Unites Five Counties . . . Completes Highway from Atlantic City to San Francisco

ter-goers, and tourists. The bridge, which is owned by the state and operated by the Department of Public Works, cost 77,200,000 dollars, which will be paid for from automobile, truck, interurban electric train, and passenger tolls. Facilities for steam trains have not been provided. The bridge extends from Fifth Street, in down-town San Francisco, to a traffic distributing structure 6.9 miles distant on the Oakland shore, where three approaches are provided, the entrance from the most remote being 9.1 miles from San Francisco. The west section, stretching from San Francisco to Yerba Buena Island in mid-bay consists of twin suspension spans, with a center live load anchorage pier, totaling 10,450 feet in length. The Yerba Buena "span" is 2950 feet long, of which 540 feet goes through solid rock. The East Bay section consists of one 1400-foot central span cantilever, two 511-foot anchor arms, five 509-foot fixed spans and fourteen 291-foot fixed spans to fill. The bridge carries two levels, the upper for fast autos, the lower for trucks and interurban railway. Across the main channel, on both sides of the central anchorage, the spans stand 214 feet above high water. Whereas vehicular traffic already is using the bridge, electric railway crossings will not commence until January, 1938.

Motorists entering and leaving the Oakland end of the bridge will use this di tion structure on which there will be no right-angle crossings or left

One of the breaks in the bridge structure, designed to allow for expansion and contraction due to temperature changes, is shown in the photograph below. The spans may move as much as nine inches. Note that even the cross braces are separate units

*Below:* One of the completed towers of the suspension sp all cables in place. An aerial beacon will top the s



# Oil Emulsions

## A Research Step Toward a Comprehension of Living Protoplasm . . . Chemicals Imitate Simplest Forms of Life . . . How To Demonstrate

By Dr. P. A. YOUNG
Formerly Research Botanist, Montana Agricultural Experiment Station

PROTOPLASM, the carrier of life, is the only living emulsion. However, certain inanimate emulsions act alive. Thus, besides the extremely complex emulsion of protoplasm, we are much interested in the simpler emulsions that we use in foods and industries. For example, milk, butter, and mayonnaise dressing are emulsions commonly used for foods, while orchardists use petroleum oil emulsions as sprays to kill insects.

Interest in emulsions is stimulated not only by their vital and industrial importance but also because some artificially made emulsions and colloidal systems show movement, enlargement, and shapes so amazing that they appear to be alive. I made such a life-like, artificial emulsion by mixing water, petroleum oil, and the automatic emulsifier called "cresoap." This cresoap is a mixture of soft soap and cresol.

It is easy to watch emulsions make themselves and act alive; the experiment may be conducted as follows: 10% of cresoap is dissolved in automobile cylinder oil. Then a drop of this miscible oil is placed on a microscope slide, and beside the drop of oil is placed a drop of water (Figure 1). For high magnifications, place a cover-glass, supported by fragments of glass (V, Figure 2), over a drop of oil and then let water run under this glass to touch the oil.

To see the phenomena of emulsification, place the glass slide on a microscope, and dim the light. Then stick a needle into the drop of water and push one edge of it until it touches the drop of oil. Fast, extremely interesting action follows while the oil and water emulsify in each other before your eyes.

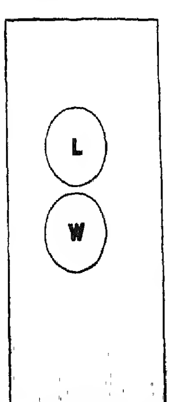



*Figure 1*

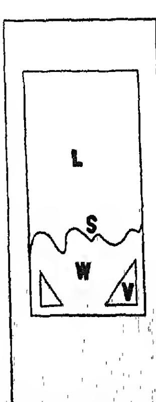



*Figure 2*

A thick black wall (the main interface, Figure 3, S) appears instantly when the oil touches the water. Then the oil suddenly squirts through holes in this wall and within three seconds it disperses millions of globules of oil in the water, as an atomizer sprays droplets of water into the air. This makes an oil-in-water emulsion, because an emulsion consists of globules of one kind of liquid suspended in another kind of liquid in which these globules do not dissolve.

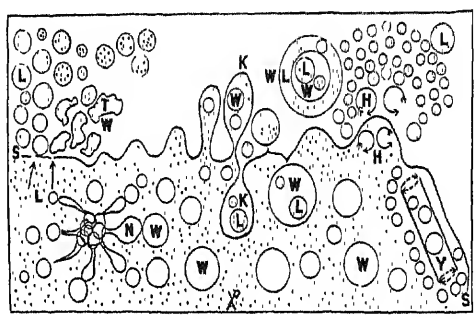


***Figure 3:*** **Drawing of phenomena of emulsification, magnified 250 times. The formations and actions indicated by letters on the drawing are fully described in the accompanying text**

However, some of these streams of oil do not instantly form fogs of oil in the water (Figures 4, 5). Instead, the streams of oil become large masses that move like the tiny animals of naked living protoplasm called amoeba (Figure 3, T).

DURING the first few seconds, the oil and water violently mix themselves and isolate a large mass of water in the oil. Then the mass of water thrusts out long necks (Figure 3, N) and soon globules of water are cut off into the oil, much as a living fungus called a mildew grows a thread that cuts off little reproductive cells called spores. But the mildew slowly forms its spores or seeds by vital processes, while, in contrast, the mass of water passively responds to surface tension by which suspended liquids become spheres. It is not alive.

The interface (Figure 3, S) between the drops of water and oil then begins serpentine undulations and even makes big bulges that become knobs (Figure 3, K). Many of these bulges become constricted at their bases and cut off large globules of oil in the water, and spheres of water in the oil. Besides the simple globules of oil and water, the bulging interface forms very many complex globules. Knobs containing emulsions are cut off and thus make complicated globules in the oil and water (Figure 3, L, W).

In water, the most complex oil globule contains a large sphere of water, and inside this sphere are little oil globules that dance rapidly as though alive. Thus, they resemble bacteria that similarly dance in water. However, the living bacteria that swim are recognized when they move in straight lines. In contrast, dead bacteria and similar microscopic particles only dance in one place and do not go anywhere. But if they are not alive, how can they dance? The tiny oil globules and dead bacteria dance because they are moved when water molecules bombard them. This is called the Brownian movement, and is imitated and exemplified by the hula dance of the grass skirts.

Suddenly, when making the experiment, two whirlpools will start to swirl in opposite directions beside the interface, and as they swirl, layer after layer of oil globules appear in the water across the wall (Figures 3, H; 4, 5). Also, cylindrical currents roll in the oil beside the interface (Figure 3, Y; 4). These cylindrical and horizontal currents evidently cause emulsification.

When I dissolved a red stain in the oil and a blue stain in the water in trying to make the emulsion easier to understand, the opposite result happened. The blue emulsion was so complex that it took three years to understand it. The blue stain reacted with the cresoap and

# That Act Alive

produced a separate emulsion of blue globules in both oil and water (Figures 5, 6) besides everything shown in Figure 3. Most of the blue spheres were inside oil globules. A peculiar change occurred when these oil globules adhered to glass. The oil globules became egg-shaped while the inclosed blue spheres became marginal masses and zebra-like stripes (Figure 7).

It is very interesting to comprehend the size of particles suspended in water, such as the silt in a river or the cream in milk. Emulsified oil globules are some of the smallest of visible objects. In my petroleum-oil emulsions, the largest oil globules are 1/1000 of an inch in diameter, while the smallest ones visible are 1/250,000 of an inch in diameter. It is difficult to imagine such small things, but let us try to visualize the size of the smallest oil globules. If we arranged 15,000 of them in a row, they would extend all of the way across a pin head. And if we arranged only a million of these oil globules on a square, we could hardly see the grease spot.

THE function of science is to describe natural phenomena, but discoveries are more interesting and useful when we try to explain how the phenomena happen. Soap is the key to the mystery of emulsions. When water touches the miscible oil, the cresoap rapidly makes a broad black wall (the main interface) between the oil and water. As the cresoap then dissolves in the water and the surface tensions change, the main interface wriggles and the horizontal and vertical currents rotate in emulsifying the oil and water in each other.

The dissolved soap has the remarkable power of accumulating as a tough sphere (interface) around each globule of oil. When oil globules are so protected, they bump together and bounce away from each other like rubber balls, for the spheres of soap act like rubber membranes. Also, each oil globule bears a negative electric charge by which it repels the other globules. Thus, their static keeps them apart.

*Figure 4:* **Showing emulsification of oil in water (below black wall) and water in oil (above the black wall). Magnified approximately 20 times**

Emulsions that were forming exhibited flowing and revolving movements resembling those that I have often seen in living protoplasm, as when protoplasm flowed into organs of the alga, Vaucheria. Other research workers also have exhibited remarkably life-like structures, movements, and enlargements of inanimate chemicals. These phenomena are interesting, but let us clearly recognize the fact that these man-made materials are not alive, and can exhibit only passive responses to the laws of physics and chemistry. As a living creature, man transmits the life he inherits, but man has never created life.

*Figure 5:* **Two horizontal swirls with water spheres in oil above the black line and oil globules in water below. Magnified about 20 times**

Far transcending man's imitations, protoplasm really performs the following characteristic living functions: It responds to stimuli but often responds differently to the same stimulus. It moves voluntarily and produces living appendages with which it swims, runs, or flies. It digests foods, grows from the inside, and builds living tissues from synthetic chemicals including the infinitely complex proteins that characterize the species. Protoplasm and the green chlorophyll of plants use light energy in making sugar from carbon dioxide and water, thus supplying all of the food in the world. And most marvelous of all, protoplasm precisely reproduces its species.

Although non-living chemicals do not really perform the fundamental functions of life, we learn much about life by studying inanimate materials. Like them, living creatures also passively react to environment, as in being moved by a machine or water.

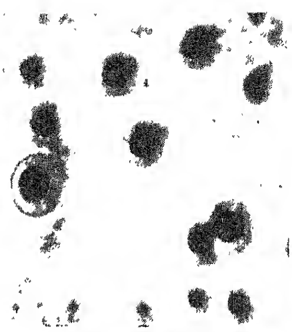


*Figure 6:* **Blue globules inside oil globules emulsified in water. 300x**

Clearly, inanimate chemicals can imitate only the simplest forms of life. A drop of compressed, salty gelatine may superficially resemble the living protoplasm of an amoeba, and chemical flowers growing by accretion in solutions of salts slightly resemble plants, but it is easier to distinguish a living man from his brazen images in statues.

Research work with forming emulsions has increased our knowledge of the emulsions used in our foods and industries. The better we understand these simple emulsions, the better we understand the bewildering complexity of protoplasmic emulsions, and comprehend how greatly living protoplasm exceeds the imitations of life.

A research worker approaches the boundary of knowledge to study the laws of Nature. He starts with dimly comprehended mysteries, and feels gratified when his years of work net discoveries that help people in understanding these mysteries. It is helpful to recognize the extreme difference between magic and science. Man does well to approach with humility the study of Nature, and especially the study of protoplasm which is the most profound of earth's mysteries.

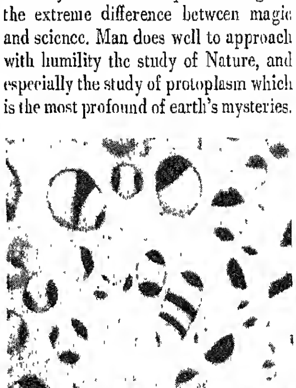
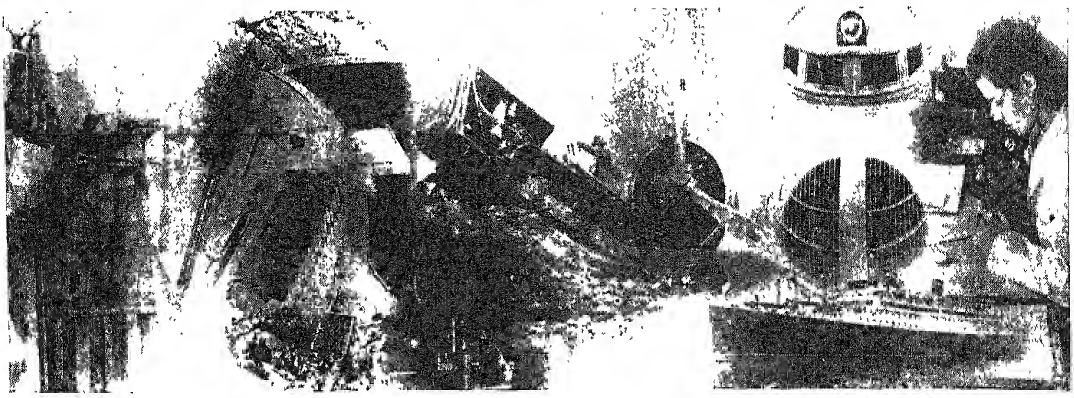


*Figure 7:* **Zebra-like stripes on egg-shaped oil globules adhering to glass. Magnified approximately 200 times**



# THE SCIENTIFIC AMERICAN DIGEST

Conducted by F. D. McHUGH

Contributing Editors

ALEXANDER KLEMIN
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D. H. KILLEFFER
Chemical Engineer

## Australia Claims Oldest Live Thing

QUEENSLAND, Australia, claims to have the oldest living thing on earth. It is a macrozamia, a tree about 20 feet in height and estimated to be more than 12,000 years old.

In the Tamborine Mountain reserve there is a whole grove of macrozamia, the young-

Not as majestic as our sequoias, but older—this Australian macrozamia is more than 12,000 years old

est of them being three feet in height and 3000 years old. When Professor Chamberlain, of Chicago University, was appointed to collect data concerning macrozamias in various parts of the world, he travelled all over the globe, and the largest specimen he had seen prior to coming to Queensland was between six and seven feet in height and was found in South Africa.

He was amazed, therefore, when he found in the Tamborine Mountain reserve a grove of macrozamia which measured over 20 feet in height, and whose ages he estimated to be between 12,000 and 15,000 years. The largest macrozamia cone which Professor Chamberlain had ever seen, weighed 85 of 35 pounds, and contained 151 seeds. These were sent to America. One seed was planted in each of America's 151 national parks. Now each of the seeds has germinated, so that a descendant of Queensland's macrozamia is now growing in each of the national parks of America.—*Australian Press Bureau.*

## Telepathy's Reality

"THERE are many obvious ways in which the brain's level of performance could be raised," said Professor Julian S. Huxley, leading British biologist, recently. "If for all the main attributes of mind the average of a population could be raised to the level now attained by the best endowed ten-thousandth or even thousandth, that alone would be of far-reaching evolutionary significance. Nor is there any reason to suppose that such quantitative increase could not be pushed beyond its present limits.

"There are other faculties, the bare existence of which is as yet scarcely established. These too might be developed until they were as commonly distributed as, say, musical or mathematical gifts are today. I refer to telepathy and other extra-sensory activities of mind, which the work of Rhine, Salter, and others is now forcing into scientific recognition."

**CAR AGE**

**ACCORDING to the American Petroleum Institute, the average motor car now in use is nearly five years old.**

## Cheaper Cyclopropane

CYCLOPROPANE has been widely adopted during the past few years as an anesthetic despite the fact that its cost has been in the neighborhood of 20 dollars a pound. The reason for its high cost has been the fact that the only practicable method for its preparation used as a raw

Courtesy Mrs. Hilda Curtis, Mt. Tamborine Australia

material tri-methylene glycol, a minor impurity in glycerol produced by the soap industry. Not only is this raw material expensive but the process for its conversion to cyclopropane is difficult and consumes bromine which itself is not cheap.

The success of the new anesthetic in the hands of the medical and dental professions encouraged research workers at Purdue University to seek a cheaper method for its preparation. As a result of their efforts, cyclopropane is now prepared on a much larger scale than before, using propane, a gas abundant in natural gas and plentiful around petroleum refineries, as the raw material. The common propane consists of three carbon atoms in a straight chain with eight hydrogen atoms attached to them, while in cyclopropane the three carbon atoms form a ring to which six hydrogen atoms are attached. To start this game of ring-around-the-rosy one hydrogen atom at each end of the chain is replaced by a chlorine atom and subsequently the two chlorine atoms are removed under such circumstances that the two end carbon atoms join hands. This process, which is now in successful operation, consumes cheap raw materials, chlorine and propane, and provides an ample supply of cyclopropane for use as an anesthetic.

Cyclopropane is preferred to ethylene as an anesthetic and may be used in some cases where other anesthetics might cause trouble. *—D. H. K.*

## ELECTRIC BED COVER

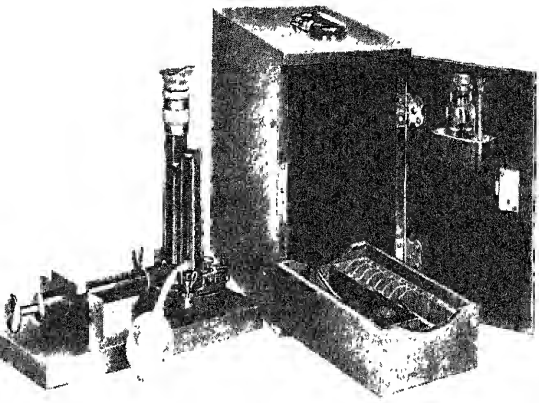
A SOLUTION for the problems of wintertime's impatient sufferers who either wear themselves out beneath a heavy load of blankets or wake shivering under too few has been found in the new electric comforter developed by W. K. Kearsley of the General Electric research laboratory. Plugged into a household circuit, the electric comforter obviates the necessity for any other form of covering, yet automatically keeps the sleeper comfortably warm regardless of any changes in the temperature of the room. Unlike ordinary heating pads, the comforter will give a gentle warmth over a large area, replacing the heat loss from the bed. It is not designed to give concentrated heat at any given point. The new aid to sleeping comfort has been developed and completely tested in actual use over a period of many months.

The electric bed cover folded; the

The comforter is composed of two thicknesses of a lightweight material. Between these two outside coverings, many feet of fine, flexible, conducting wire have been sewn in a zig-zag pattern. Both ends of the wire are brought to a terminal at the end of the comforter which is used at the foot of the bed. From this terminal a cord leads to a small control box which contains an adjusting mechanism, a thermostat, and a transformer. The control box may be located on a night table near the head of the bed and its extension cord plugged into a nearby convenience outlet. On the face of the box is an on-and-off switch and a control knob which regulates the amount of heat produced by the comforter.

The electric comforter has several safety features. It cannot get too hot, nor can a person get an electrical shock from it. A transformer in the control box changes household current to 23 volts and makes the comforter a safe, low-voltage device. Inside the comforter are several small thermostats which are capable of opening the circuit and shutting off the current in case unusual temperatures result from such abnormal usage as piling up or rolling the comforter while the current is on. Once a user has set the rheostat on the control box at the desired place, the main thermostat will maintain that temperature regardless of changing weather conditions.

Sample electric comforters have been made in both single and double bed sizes. The length of material necessary for tucking in at the foot and sides of the bed is not heated. The comforter can be washed like a blanket. The electrical energy consumed depends upon the room temperature, averaging about that of a 100-watt household lamp.



The dust counter equipment complete with its carrying case. *Below:* Using the dark-field microscope viewing-and-counting system. Note the sampling pump

## DUST-CONTROL "METER"

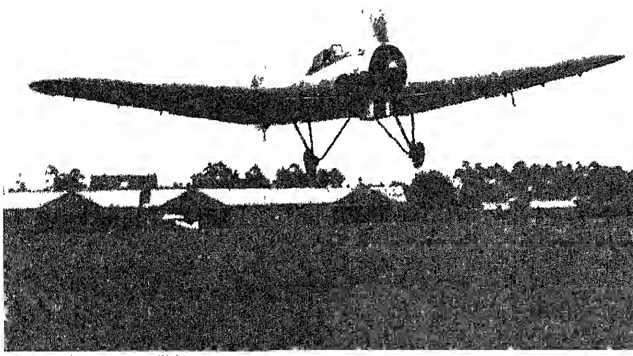
FOR use in determining the degree of danger of dusty operations, Bausch & Lomb have developed and are offering to industry through the Willson safety service in a remarkable manner the problem of dust control.

There is nothing to set up where a dust count is to be taken as in the case of other available equipment. The operator can enter the room, take the sample, and leave in less than 15 seconds without interfering with routine or interrupting production. Requiring no technical supervision or skill to operate, daily or hourly checks of dust conditions (sometimes a necessity for protection against unjust claims) can be made readily without fuss or bother.

This new dust counter combines in one unit the necessary air-sampling device and a dark-field microscope viewing-and-counting system. No accessory laboratory equipment is needed. Suitably cased for transporting, the complete outfit weighs but twelve and a half pounds.

## WINDBURN IS SUNBURN

WIND alone does not burn the skin. Cases of windburn, so called, are really cases of sunburn in which the wind has helped the sun along by making the skin



Photographs courtesy of *Flight*

**The monoplane in which Squadron Leader Swain set a new altitude record**

the sun. Wind-tunnel experiments supporting this belief are reported by Dr. W. H. Crew of New York University and Dr. C. H. Whittle of Addenbrooke's Hospital, Cambridge, England.

In one of the experiments, one of the investigators exposed his forearm to the blast of a 40-mile per hour wind in an experimental wind-tunnel. The forearm was covered by automobile tire inner tubing except for a small area about one inch square where the rubber was cut away, leaving the bare skin exposed to the blast. No ultra-violet light was present.

"During the half-hour exposure to the blast the skin exhibited 'goose flesh,'" the report states, "but at no subsequent time was there the slightest evidence of reddening or chapping of the exposed area of the skin."

Cases of wind having caused burning of the skin are due, in their opinion, to the wind's having made the skin more susceptible to the ultra-violet rays by changing the temperature and moisture of the skin and by suppressing perspiration. Perspiration, they found in other experiments, can provide some protection from the actinic rays of sunlight.—*Science Service.*

## World's Altitude Record

RECORDS, whether of speed, altitude, or duration, pass from nation to nation, with the exchange bringing no ill feeling. For many years the world's altitude record was held by the United States. Then it passed to France. Now it has been gained by Great Britain, with the sole result that Americans will be all the more determined to excel their previous efforts.

The latest altitude record was set by Squadron Leader F. R. D. Swain of the Royal Air Force, when he reached a height of 49,967 feet.

His machine, specially built for the flight, was a Bristol low-wing monoplane, equipped with a Pegasus engine, provided with a powerful two-stage supercharger. The propeller, four-bladed, was over-size so that it could function in thin air. To climb to great heights, the plane must have a large wing area and spread, as well as power maintained to the greatest heights. The first requirement explains why the Bristol Type

**Squadron Leader Swain in his hermetically sealed high-altitude suit**

weight 5310 pounds, and its loading per square foot only 8.5 pounds with a total wing area of approximately 620 square feet.

But interesting as the airplane was, with every possible device to secure lightness, insulation from cold, and so on, the more interesting part of the equipment lies in the means which made it possible for the pilot to live, in reasonable comfort, at great heights.

The pilot wore a special suit of rubberized fabric, fitted with a helmet of the same material with a large curved double window of transparent plastic material. Inside this suit the pilot was isolated from all external conditions. He breathed oxygen in a closed circuit, fed at the required rate. The gas entered the helmet at the right side of the face. The outlet was on the left, and from this came the gas containing the exhaled breath. The gas then flowed to a canister filled with chemicals which absorbed the carbon dioxide and moisture of the man's

Besides being supplied with oxygen, the pilot had to have his helmet and suit supercharged. The pressure suit maintained the pilot's body at two pounds to the square inch above the pressure of the external atmosphere. This gave the flier the equivalent of flying with oxygen at about 43,000 feet altitude, the maximum practical height without supercharging.

But in spite of the electrically heated clothing, the oxygen supply, and the "supercharged" suit, Squadron Leader Swain had a terrible experience. He spent three hours and twenty minutes on his journey to a level nearly twice as high as the peak of Mount Everest. For about two hours he flew near the 50,000 feet level. The duration of his journey under these highly artificial conditions explains fully the loss of strength which he experienced and his terrifying adventures. The cockpit cabin windows and the window of tough transparent plastic material in his helmet glazed over and he could see nothing, not even the instruments on the panel in front of him. This worried him a good deal. He could not read his compass, did not know the direction in which he was traveling, and therefore flew erratically. On the descent he felt suffocated and had the impression that he was running short of oxygen. He thought of opening the cockpit cover and pressed the lever which should have opened the cover. Unfortunately this did not work. Finally he got hold of a knife and cut open the window of the helmet at 14,000. With the rush of fresh air he felt better immediately.

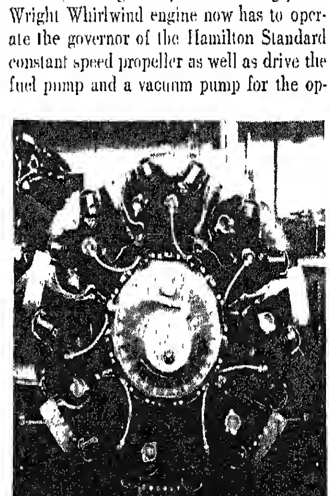
The Air Ministry is of the opinion that even this record can be improved and announces: "It is hoped that after further experience with this new aircraft and its novel equipment, still greater heights may yet be reached."

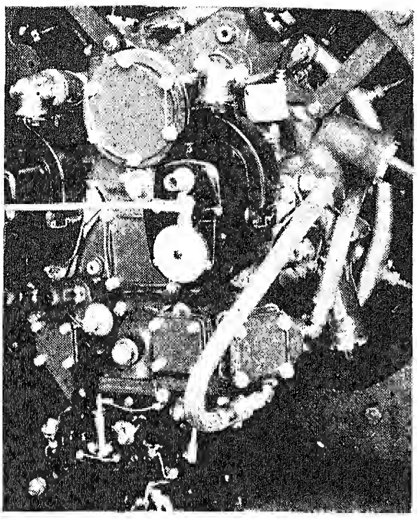
Of course, such records serve not only to thrill the world but to provide scientific information for stratosphere flying in the future.—*A. K.*

## Complexity of the Modern Aircraft Engine

THE most astounding feature of the modern aircraft engine, besides its reliability and lightness for a given power, is the complexity of its functions. And every six months or so the engineers add another.

Thus, among many other things, the Wright Whirlwind engine now has to operate the governor of the Hamilton Standard constant speed propeller as well as drive the fuel pump and a vacuum pump for the op-





Rear view of engine showing the accessories described in the text

eration of the automatic pilot or the artificial horizon.

To carry out these three functions most readily and simply, a "three-way drive" has been incorporated in the rear end of the Whirlwind engine. The new accessory drive, attached below the right magneto at the fuel-pump drive location, is a gear box using beveled gears with three outlets. The right hand outlet of the three-way drive takes the Hamilton Standard governor pump and regulator; the left hand outlet a vacuum pump; and the lower outlet the fuel pump. The photograph shows the complexity of the rear end, with magnetos, drives, oil lines, and what not, all crammed into the smallest possible space.

The front view photograph shows the very latest embodiment of the Wright Whirlwinds. They seem to change and advance continuously. Our readers will perhaps note the flexible oil line which runs from the constant speed propeller governor to the nose section. Oil lines, unless very short, are invariably flexible in aircraft practice—as they should be in view of the tremendous power and inevitable vibration.—*A. K.*

**LIGHTER AIRPLANES**

**IN 1925, less than 10 percent of the structural weight of aircraft built in the United States was of aluminum or aluminum alloy. By contrast, this metal and its alloys now constitute over 70 percent.**

## Aircraft Engine Science in Review

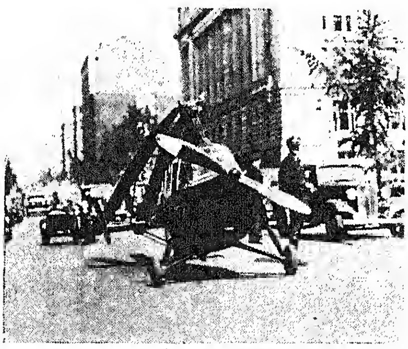
THE design and construction of the aircraft engine require ingenuity and mechanical skill of a high order, but they also require a tremendous amount of fundamental knowledge and many laborious calculations. While scientific reports and papers on aircraft engines stream from the laboratories, there are comparatively few books on the subject. Probably this is because the active designers are too busy designing to find time to write. We welcome, therefore, an addition to the literature on this subject in Domonoske's and Finch's "Aircraft Engine is in good part due to a better understanding of detonation and the use of higher octane fuels. Hence the chapter on "Detonation and Antidetonants" is most interesting reading. At present, 100 octane fuels at reasonable prices are actually in sight. The combustion processes of the cylinder are now studied in the most thorough-going fashion, and the chapter entitled "Combustion Processes in Aircraft Engines" deals interestingly with such topics as flame propagation, the influence of mixture ratio, and so on.

We are constantly mentioning supercharging in these columns. A chapter devoted to "Supercharging" really gives the key to the maintenance of power, the altitude control of supercharging, and similar problems. Have our readers realized how difficult it is to cowl an engine, yet cool it properly without increasing the head resistance? Or how to design the fins so that they may give the required cooling, be closely spaced, be integral with the cylinder, yet be capable of practical manufacture? The book covers these questions admirably, is a fine text, yet it is of real interest to anyone wishing to acquire a real knowledge of the engine designer's art.—*A. K.*

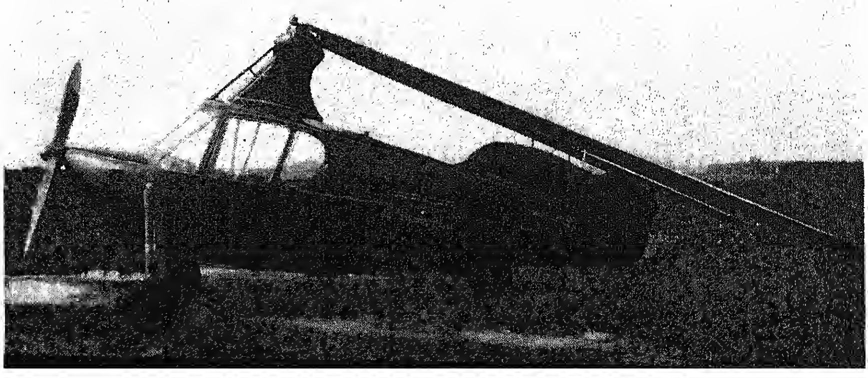
## Roadable Autogiro

QUITE recently Jim Ray, veteran pilot and Vice-President of the Autogiro Company of America, landed his 'giro in a small downtown park just north of the Department of Commerce building, Washington, D. C., folded back the rotors over the fuselage, engaged the tail wheel with a transmission from the engine and drove comfortably through crowded streets to the door of the Department.

The "Roadable Autogiro," as it is called, was specified by John H. Geisse, designed by Messrs. Larsen and Stanley, and built by the Autogiro Company in an effort to solve that irritating difficulty of private flying—the long distance from the landing field to the owner's home. The new craft meets this difficulty by its "roadability"—its ability to operate on the highways.



***Above:*** **The roadable Autogiro in a city street.** ***Below:*** **Side view of the 'giro with the two vanes folded ready to be run along any highway**



As the 'giro is still undergoing final acceptance tests, very little information has been released to date. Our two photographs and the following brief description will suffice, nevertheless, to give a fair idea of its characteristics.

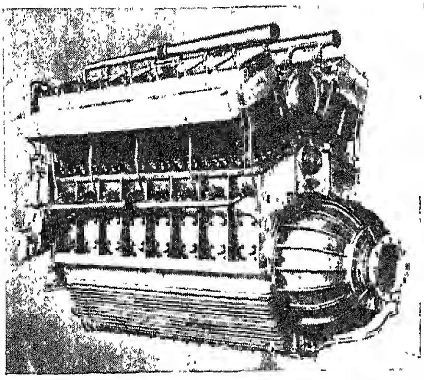
A two-bladed rotor is employed, with no fixed wings. The rotor is of the type in which control is achieved by tilting, and, although a rudder is provided, it is only to be used in emergencies. By loosening two pins, the blades may be folded back and fastened down at the tail in the space of a few minutes. The engine, which is placed in rear of the cabin, is provided with three transmissions. One long transmission shaft from the front end of the engine leads to the forward propeller. In this transmission a clutch is provided so that the propeller can be disconnected from the engine for road work. Another drive leads to the rotors and can be used for starting purposes, when the rotor blades have to be brought up to speed. A third drive from the rear of the engine leads to the tail wheel which serves for propulsion on the ground. One or two of the three transmissions can be put into simultaneous operation as required.

Pilot and passenger sit side by side in an enclosed cockpit of generous dimensions. With the engine in the rear, visibility is excellent. Since the landing speed is only 20 miles per hour, and the take-off run is only 150 feet, small fields can be used, and large airports are no longer necessary. The top speed is only 90 miles an hour, which is slow for flying, but there is no reason why this speed should not be increased in subsequent models.

It is impossible to say what service experience will show. But at any rate here is a thoroughly interesting and worthwhile experiment.—*A. K.*

## The "Hindenburg's" Diesels

THE *Graf Zeppelin,* when built eight years ago, was equipped with five 450-horsepower Maybach gasoline engines. When the *Hindenburg* was designed, it was quite properly decided that Diesel engines burning heavy, non-inflammable fuel oil should be employed. The safety and fuel economy advantages of the Diesels are obvious. One of our photographs shows the



One of the 12-cylinder, V-type, water-cooled Diesel engines used in the *Hindenburg*. With a cruising output of 800 to 900 horsepower, these engines are capable of a maximum output of 1200 horsepower

Daimler-Benz 12-cylinder, V-type, water-cooled Diesel as finally developed.

Here are the specifications of this sturdy prime mover: A cruising output of between 800 and 900 horsepower; a fuel consumption of not more than .396 pounds per horsepower hour; a maximum output of 1200 horsepower for emergencies. Thus there is an enormous reserve of power.

The motor is reversible so that the propellers need no variable pitch mechanism. Because of inclinations in flight, two oil suction pumps are provided. Compressed air bottles are used for starting.—*A. K.*

## "Old-Timers" in Aviation

THE "old-timers" in aviation are still relatively young men. The pioneers were young almost without exception, and flying is only a young art after all. The early American fliers were a remarkable body of men—daring, adventurous, romantic. They have had varied and curious careers. Some, like Glenn L. Martin, have achieved not only fame, but also leadership in the industry. Others have become purely "has-beens" whose sole connection with aviation is in gossip at the flying fields or at the meetings of the Early Birdmen. Others, without achieving fortune, have steadily and creditably pursued careers in this field, with solid reputation as one of their rewards.

Two fine examples of these early fliers are Richard H. Depew, Jr., and Beckwith Havens, who recently celebrated their 25th flying birthday. Both learned to fly in 1911, with Mr. Havens as the senior by a few months. Both have flown every type of plane, under all sorts of conditions. Captain Depew estimates that he has flown 119 types in all. He is known as one of the most conservative pilots, though one of the most courageous. It is his conservatism which explains the fact that he has never been injured in an accident, even though he was an Army test pilot during the war.

To "take a chance" is the American motto. These men illustrate the wisdom of a contrary attitude of mind. The two pilots are partners at Roosevelt Field, engaged in selling a well known and popular make of private airplane. It is interesting to contrast, in the photographs, the pusher Farman in which Captain Depew made his first flight to the modern Fairchild by the side of which the two men are standing. The rough wooden propeller of the Farman has given place to a finely shaped blade, metal tipped, protected with a spinner. The engine is completely cowled in with only a small opening at the front end for cooling. There is still some external bracing, but the forest of struts and wires has disappeared. The pilot and passengers sit in an automobile-like cabin instead of being exposed to the airstream. It is interesting to note the horizontal surfaces placed at the front of the Farman and the skid to guard against nosing over. The front skid will never come back, but a front wheel to serve the same purpose is being employed today and may indeed become very popular.—*A. K.*

## Flying Doctor

COLONEL Lindbergh's remarks before the German Aero Club, pointing out the terrible destructiveness of modern aircraft, really hurt. Thus every man vitally concerned with aviation is apt to note with pleasure any humanitarian service that aircraft can render. From Australia comes an item of welcome news. With a total population numbering less than that of New York City, Australia embraces an entire island continent. Thousands of people may have no neighbors nearer than a hundred miles or more. Therefore, the Commonwealth of Australia, thanks to the imagination of the Rev. John Flynn, a Presbyterian minister, has established an aerial medical service. Cheap radio transmitting and receiving sets have been developed, which are portable and can be put into action as soon as the aerial is hung to a tree. Thus the flying doctor is enabled to keep in touch with a vast region. The flying doctor in Western Queensland carries complete medical equipment in his airplane, flies on an average 20,000 miles a year and attends directly to about 250 patients including the aboriginal natives. Sometimes treatment is directed by wireless; sometimes patients are rushed by plane to hospitals.—*A. K.*

**STRATOSPHERE**

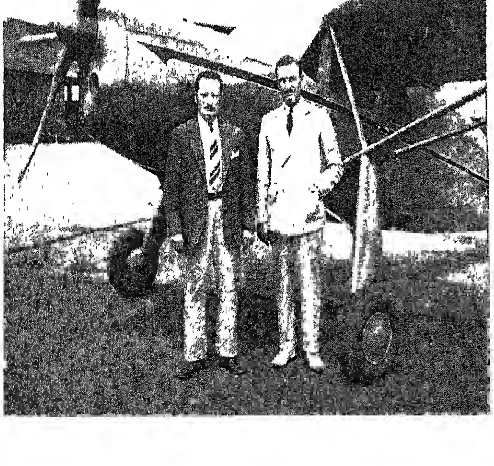
**ALTITUDE records of over 100,000 feet into the stratosphere have been made by balloons carrying scientific apparatus. This is more than twice the height reached by record-breaking airplanes.**

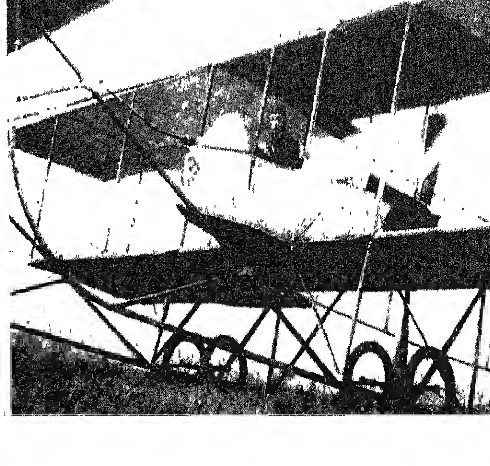
## Larger Flying Boats

THE Glenn L. Martin and Sikorsky companies were the pioneers in the construction of the Pan American *Clippers*. No doubt it was a great disappointment to these companies that Pan American should have placed its order for six even larger *Clippers* with the Boeing Aircraft Company. Boeing, a newcomer to the large flying-boat field, is a splendid organization, however, and will certainly live up to its great opportunity.

The new Boeing *Clippers* are still in the design stage, with the engineers busily testing in the wind tunnel and making calculations of performance, strength, and so forth. Nevertheless, the first of these aeromarine giants will be ready by the fall of 1937.

The boats will be much larger than either the Martin or the Sikorsky ships, will have a gross weight of more than 82,000 pounds,





and will carry 60 passengers with sleeper accommodations for 40. They will have the enormous wing spread of 152 feet, a length of 109 feet, and an over-all height of 28 feet. Speed will be close to 200 miles an hour.

Naturally, the very highest degree of streamlining will be employed. The monoplane construction will be of the high-wing, internally braced type. Metal will be used throughout.

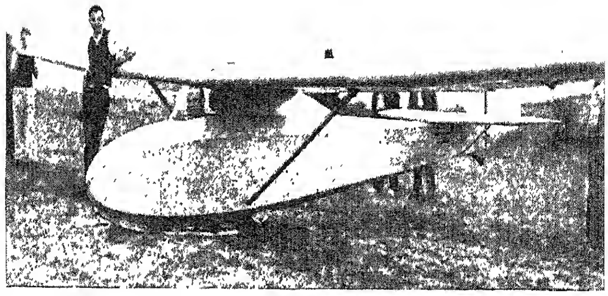
The specifications for the Boeing flying boats were written by the engineers of Pan American after service experience with the older *Clippers*, and the terms of the specifications settle, at least temporarily, the following argument: Should wing-tip floats be employed for lateral stabilization, or should sea wings, which are short stub-wings placed on the side of the flying-boat hull. Apparently stub-wings have won the day. The obvious arguments in their favor are that they are sturdier in rough water, provide more planing area, and offer less aerodynamic resistance.

As regards accommodations, the new boats will contain two full decks. The upper deck will house an elaborate control cabin, crew's quarters, and baggage compartment. The lower deck will contain luxurious day and night passenger accommodations, galley, lavatories, and dressing rooms. Passage-ways will be provided through the wings to the engine nacelles to permit servicing and inspection of engines during flight. Soundproofing, heating, ventilation, seating, lighting, and so on are now thoroughly well understood and will most certainly be provided in the most approved manner.

Our flying boats may some day rival ocean liners in size and comfort; they surpass them enormously, as our readers know, in speed.—*A. K.*

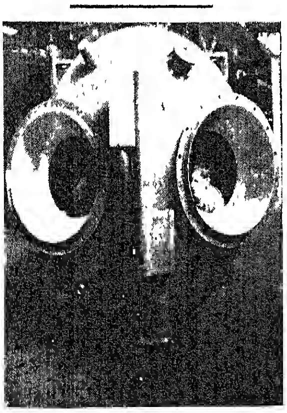
## Reviving Glider Interest

THE meeting of the Soaring Society of America at Elmira was a great success and will do much to increase interest in gliding, which remains the real sport of aviation. The world's distance record of 158 miles made by Richard C. du Pont remained unbroken, although Henry Nicoll Wightmann of Upper Montclair, New Jersey, made a good flight of 135 miles this year. Mr. du Pont secured another world's record, however—a distance of 37 miles from point of departure and return. In this type of flight, for which the pilot announces his intention beforehand, the pilot on the outgoing trip rides a favorable wind and is supported by thermal currents. But the return trip is a much trickier proposition; the wind currents may now be adverse, and great skill is required.



R. C. du Pont in his imported sailplane *Goppingen I*

Mr. du Pont made his round trip record in a German built sailplane, the *Göppingen I*, which is illustrated in one of our photographs. Gliders do not change radically in form. The *Göppingen I* is merely the fine flower of streamline design, with very long span and high aspect ratio, minimum external bracing, and so on.—*A. K.*



A two-eyed monster—but at first glance only—for a closer examination will show that it is the tank of a large oil circuit breaker that has been laid on its side to assist the workmen who are installing the bushings and internal mechanism. This unusual photograph was taken recently in the Philadelphia works

## Gas—Alert!

WE have always been warned against searching for gas leaks with a flame, yet a gas leak detector recently developed employs a flame as its agent of detection. The differenee is that this detector is to be used only in searching for leaks of the non-combustible halide gases, which have, in recent years, been widely adapted to both domestic and industrial refrigeration. Since these gases are relatively odorless, tasteless, and colorless, some such device is necessary to discover leaks while cooling units are being installed and also during servicing.

Looking for gas leaks with a flame!

The Prest-O-Lite halide leak detector consists essentially of a handle with a needle valve and a burner which includes a suction nipple for attaching a rubber hose. A chimney with a copper reaction plate fits on top of the burner. The detector is furnished ready for mounting directly on a gas tank. The detector flame is adjusted so that the top of the cone is level with or slightly above the chimney. The flame when and the detector is then ready for locating leaks.

The suction tube is used to explore around places where leaks might occur. The rapid flow of acetylene through the burner causes refrigerant gas near the open end of the suction tube to be drawn into the burner where it decomposes into free acids. These acids, coming into contact with the hot copper reaction plate, cause instant color change in the flame. A green tint indicates a small concentration of gas. When a large amount of gas is present, the flame assumes an intense violet color.

If the leak is sufficient to give considerable refrigerant gases to the atmosphere, the flame will burn with the characteristic green or violet color and might not show the exact source of the leak. In this case the leak can be located by the variation in intensity of the color of the flame. After the source of the leak has been passed, the flame clears almost instantly.

## Utilizing By-Product Ammonia

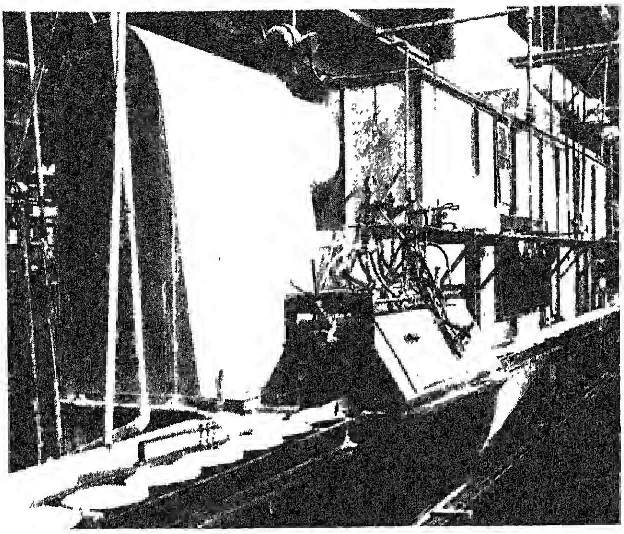
SO cheap has synthetic ammonia become as the result of development of the industry in many countries that manufactured gas plants have had difficulty in profitably disposing of the ammonia they produce as a by-product from coal distillation. In England a committee of the Institute of Gas Engineers has been studying the possibility of using this ammonia as a fertilizer in the form of ammonium bicarbonate.

Ammonium bicarbonate can be made during the process of removal of undesired carbon dioxide from the gas and at a lower cost than ammonium sulfate. Experiments are now under way to determine the value of the new product as a fertilizer ingredient. Present indications are that ammonium bicarbonate can be applied to the soil in such a way that all its ammonia content is utilized with no injury to plants.—*D. H. K.*

## Too Few Flowers Planted for Perfume

MANY plant flower beds for color and decorative masses, kitchen gardens for utility, herb gardens for savor, but only a few plant for perfume in the garden or in cut flowers.

Women of Martha Washington's time knew how to save the delicate scent of rose petals by putting them in jars with salt, or they made a potpourri of different flowers. They gathered damask, roses, and lavender and dried them to make linen



Old settling chamber (background) and new precipitator in a china plant

closets sweet, or used violet water. They liked the scent of lilies-of-the-valley and lilacs.

It is possible to plant shrubs and vines and flowering annuals and perennials to add to the fragrance of the garden—roses, English violets, carnations, and little clove pinks, and some of the fragrant peonies for indoor vases, say floriculturists in the United States Department of Agriculture. There are so many fragrant annuals and perennials for the home garden that a choice depends on preference and climate.

The perfume garden is so planned that one group of plantings is succeeded by another, each with its own appeal, such as sweet alyssum, mignonette, pinks, perennial phlox, sweet heliotrope, stock, and some of the nicotianas. Nasturtiums have a spicy fragrance. The leaves of rose geranium are both fragrant and spicy and may scent a fingerbowl or flavor a mild jelly.

The United States Department of Agriculture has a number of free bulletins with many references to flowering plants with delightful perfume.

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### FARMING

**FARMING was founded on death, in the opinion of Dr. Walter S. Landis, vice-president of the American Cyanamid Company. Flowers and fruits, placed on ancient graves, dropped their seeds on "cultivated" ground, thus showing primitive people that cultivation would provide more luxuriant growth of plants.**

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## "Pay Dirt" in a China Plant

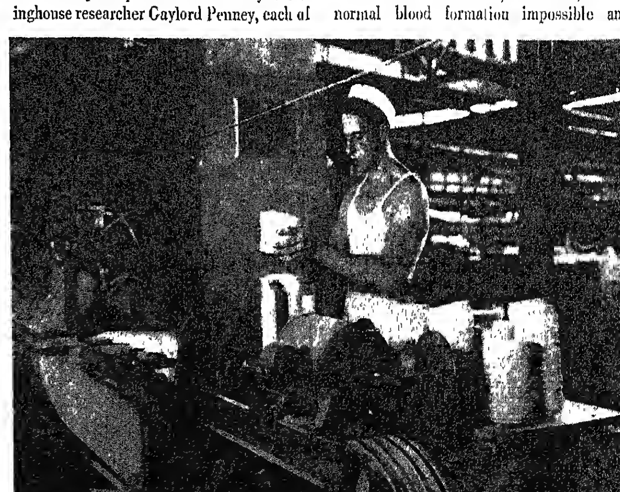
RECAPTURING four tons of china glaze a week (valued at six cents to two dollars a pound, depending upon type), ten electrostatic dust precipitators newly developed by Westinghouse and installed by Pangborn Corporation on five automatic glazing machines in the Homer Laughlin China Company, will soon pay for themselves out of savings. In addition, floor space and cleaning time are but one tenth formerly required by the settling chambers, which the 98 percent efficient electrostatic units replaced.

With each automatic machine spouting five dishes a second, or 8000 dozen daily, and spraying eight gallons of liquid glaze mixture a minute, the huge settling chambers previously salvaged 1200 pounds per week of expensive ingredients from the excess spray; but cleaning was a difficult, time-consuming, and unhealthful task. The present electrostatic glaze-saver snares particles as small as one micron in size, collects an extra 400 pounds of glaze per week, makes available 300 square feet of additional floor space per machine, and the deposited material is collected by merely hosing-out the ionizing chamber with water.

In operation, the glaze collected on the precipitator plates falls back into the booth and is immediately fed into the recirculating glaze; the only cleaning necessary is to remove at the end of a day the small quantity of glaze which has collected on the plates.

New in principle and invented by Westinghouse researcher Gaylord Penney, each of these self-contained electronic precipitators first ionizes incoming particles with 15,000 volts direct current and subsequently attracts the charged particles to deposit plates by a 7500 volt direct current electrostatic field in the collector assembly. Operation cost is negligible, each unit when operating at full capacity consuming but 75 watts.

Such units promise unlimited application for industrial air cleaning and offer hitherto unattainable operating efficiency.



Dishes passing through the electrostatic precipitator one at a time

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### NEEDLES

**PERHAPS "the very hairs of your head *are* numbered," but now the needles on a pine tree have also been counted. Dr. A. L. MacKinney counted 325,000 needles on one tree, or a total of 4000 square feet of leaf surface which, if spread out, would cover the floors of 25 ordinary rooms.**

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## Good Diet Aids Anemia Prevention

A GOOD diet throughout life will aid in prevention of anemia, Dr. George R. Minot of Boston City Hospital told nutrition experts at the meeting of the American Dietetic Association in Boston, reports *Science Service*.

Young maidens who "foolishly feed upon trash" were recognized as particular victims of this weakening malady back in the mid-17th Century, Dr. Minot pointed out, but it is only within recent years that medical science has gained a clear recognition of the importance of nutrition in warding off this disease.

Dr. Minot, who shared in the Nobel prize award for discovering a life-saving treatment of pernicious anemia, admitted that wide gaps of knowledge still remain to be filled. But it is known, he said, that anemias may arise because the body lacks or cannot make available at least three classes of dietary substances. These are iron, vitamin C, and a mysterious substance contained abundantly in liver and, to a less degree, in certain other organs. It is this last mysterious substance which, if absent, makes normal blood formation impossible and

leads to so-called pernicious forms of anemia.

Important as good diet is in prevention of the anemias, other conditions play a part, Dr. Minot explained. Growth of the individual and physical functions, such as the bearing of children by women, may enhance the deficiency of iron that leads to an anemic condition.

**WORK**

**THE Classified Telephone Directory for the Borough of Manhattan, New York City, indicates that the ways of earning a living, in New York at least, have increased from a total of 1800 in 1911 to 7300 in 1936. These new lines of endeavor are judged from the number of headings in the Directory.**

## Spread It or Slice It

A PROCESS for manufacturing Bel Paese type cheese, a soft, very white variety of recent European origin, has been developed by scientists of the Bureau of Dairy Industry. Bel Paese is the copyright name held by the Italian manufacturer who originated it.

Similar cheeses have been marketed in Europe under the trade names of Fleur des Alpes and Schoenland. Comparatively small amounts of the Bel Paese type have been imported to this country. It has sold here at prices ranging from 60 to 85 cents a pound.

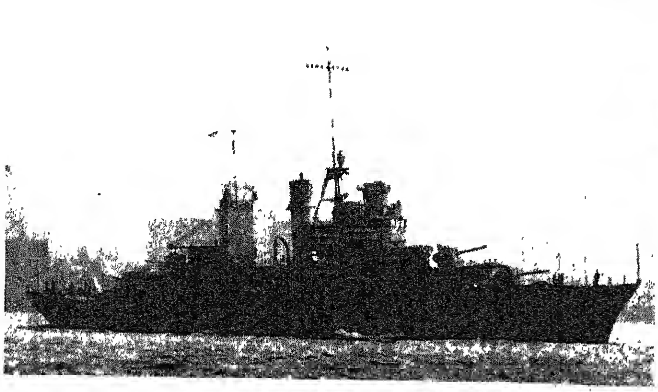
This type cheese, as made by the bureau's method and already under commercial production in Pennsylvania, has a characteristic mild, slightly salty, lactic flavor, and a soft, waxy texture which makes it desirable for both slicing and spreading. Its price is somewhat lower than that of the original.

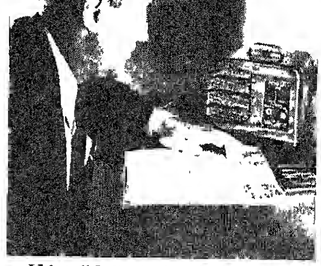
## Formidable Gunboat

A NEW type of ship was added to the United States Navy recently when the 2000-ton gunboat *Erie* sailed for her "shakedown" cruise in European waters. She had already made a number of short cruises, but this 8500-mile cruise across the Atlantic was the first extended one. After her final checking over in the Navy Yard at New York, she will go through her official trials and will then be assigned to the Special Service Squadron in Central American waters.

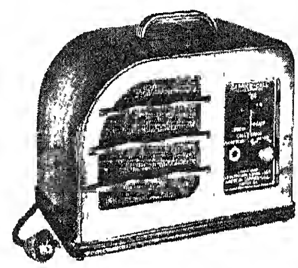
First of her kind, the *Erie* is a radically different type and is, in effect, a small but formidable cruiser, capable of performing important convoy, patrol, and independent service during wartime. A sister ship, the *Charleston*, is being completed at the Charleston Navy Yard.

The *Erie* mounts four six-inch guns, and carries a scouting plane. She will later mount 1.1 inch anti-aircraft guns. Manned by a total of 185 officers and men, she easily attained her designed speed of 20 knots in her trials.





**Using "Carrier Call," a telephone service on the electric light line. *Below:* Close-up of the combination transmitting and receiving unit**



## Plug into Light Socket and Talk

OBVIATING the necessity of special wiring circuits, a new inter-communication device was recently demonstrated before the editors in our offices. This device—the Carrier Call—operated via "wired wireless," the waves carrying voice or other signals being conducted over the electric light wires. Restricted to the electric light circuits, the operator of one instrument can talk only to the instrument tuned to his same frequency and connected to the same electric light circuit.

The Carrier Call boxes utilize several radio tubes, operating on direct or alternating current. The voice is picked up by a dynamic speaker-microphone, when the instrument is set in the "transmit" position (by means of a small lever on the front of the cabinet). When the instrument is used for reception, it gives loud-speaker volume. A flip of a switch changes either of the tuned-pair of instruments from transmitter to receiver. A signal tone for calling the other party can be sent even if the other instrument is set in the "transmit" position.

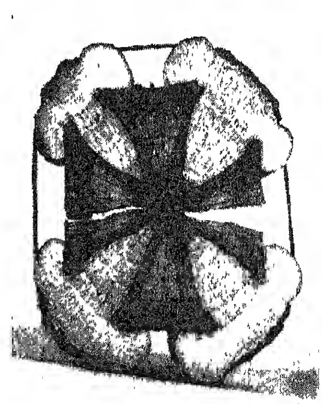
Easily portable, the instrument can be set up ready to operate in something under half a minute, making it useful in factories or plants where non-permanent two-way talk circuits are desired. The microphone is so effective that ordinary conversation registers, differing from telephones or other standard installations which require the speaker to be close to the instrument before his voice will be picked up.

The most famous use of one of the earlier Carrier Calls installed is that of a family in Westchester County, New York. Here the mother has one instrument located in the bedroom of the year-old infant in the family. The other instrument *follows* the family around the house. At dinner, it is plugged into the light circuit in the dining room. Every sound in the bedroom upstairs can be plainly heard, yet none of the sounds in the dining room are carried back to disturb the sleeping infant.

More elaborate instruments than the original Carrier Calls are now being planned for use on freight trains, operating over the rails of the railroad, or through the coupling system between the cars. With equipment of this type engineers will be in constant communication with the caboose, or with dispatchers at stations along the road.

## A Mystery in Wood—The Maltese Cross

THE photograph and story of this interesting enigma in wood was sent to the magazine *American Forests* by Christian Jensen, Secretary of the Oklahoma State Park and Forestry Association, at Norman. The specimen came from near Collinsville, Oklahoma, and Dr. Paul B. Sears, Botanist of the University of Oklahoma, gives the following as the probable explanation of the phenomena.



**A Maltese Cross in wood**

"When the trunk was seven years old it

This process cut into the wood on four sides, removing bark and cambium. At the corners, however, small patches of living bark and cambium were left. The wood segments whose cambium and bark were destroyed immediately died and took on the color of heartwood. This was due to the fact that the inner bark serves as a source of food for live cells in the wood, the food being passed toward the center by means of the wood rays.

"At the corners, however, the wood remained alive and white because the rays there could secure food from the inner bark. Growth was continued at the corners because the cambium was left in place. This growth produced an annual layer at each corner which partially healed over the dead wood forming the Maltese Cross. At that stage the trunk was cut. Had the tree been allowed to stand, it is likely that the healing would have been complete."

## Inventor Lauds Patent System

HEADED by Dr. Charles F. Kettering, a group of noted scientists, chemists, physicists, and inventors recently assembled in Washington to celebrate the Centennial of the American patent system. In this connection Dr. Leo Hendrik Baekeland, famous inventor of Velox photographic paper and Bakelite resinoid, lauded the American system of granting patents as being responsible to a large degree for inspiring and encouraging initiative and growth of American industry. He stated:

"The United States was the first country to have a real patent system for the protection of new inventions. Britain's earlier patents were merely granted as a special privilege or favor to certain industries, regardless of whether these industries were new or old. Few people realize how intensely our American patent system has contributed to the industrial and scientific development of our country. Our industries have become leaders in many branches of technology, although most of them started from very humble beginnings. They could scarcely have survived the crucial pioneer stage of early attempts if our patent system had not furnished them a period of protection against powerful or unscrupulous interests, ready to rob inventors of their brain work and initiative. Under this system individual initiative has been stimulated and encouraged, resulting in the industrial leadership which this country enjoys today."

## Modern Transportation Brings New Injuries

NEW types of injury have been created by new means of transportation, and rare types have become common, according to Dr. John J. Moorhead of New York City, reports *Science Service*.

Nearly two thirds of the injuries are due to vehicles, Dr. Moorhead said, while only one fifth occur in industry. Because of increased use of the automobile and airplane in transportation, he went on, the doctor in the most remote hamlet may be called upon at any time to treat grave injuries of some leading citizen of our country.

"The initial care given to the injured may determine the entire outcome," he pointed out. "Immediate treatment usually means

tion to early treatment, he advised that shock and hemorrhage should be immediately treated and pain promptly relieved. Anesthesia should be used more generally than it now is, he said.

Treating injuries, according to Dr. Moorhead, "is in the gadget stage of development, but complicated and fancy apparatus is more of a burden than a benefit. Safety first is the slogan in traumatic surgery; next is speed and next simplicity."

**ALUMINUM**

**WE think of America as being aluminum-conscious, but Germany now leads the world in the production of this light metal. Her 1935 production of 70,500 tons was greater than the combined production of the United States and France.**

## METHANE AS MOTOR FUEL

METHANE, the principal constituent of natural gas, is being collected, compressed to 3000 pounds per square inch, and sold to motorists in Italy in cylinders for use as a fuel. The amount so used is equivalent to a little more than 700 gallons of gasoline per day but even this is considered important in reducing Italy's necessary imports of motor fuel.—*D. H. K.*

## "TEST TUBE" BABIES—A MEDICO-LEGAL DISCUSSION

IS a "test-tube baby" legitimate or illegitimate?

The practice of artificial breeding of human infants is so new that a question of the legitimacy of the child has not yet been brought to trial.

Two New York physicians who have been working in this field—Drs. Frances I. Seymour and Alfred Koerner—have foreseen some of the legal difficulties that may arise.

1. The child's rights as a legal heir may some time be attacked.

2. The husband, some years later, may tire of his wife and try to divorce her on the grounds of adultery, giving proof of his own sterility throughout the marriage.

3. The donor of the paternal fluid may be threatened with blackmail.

4. The doctor involved may be sued as having brought about the artificial paternity without due authorization.

The two doctors have worked out schemes to prevent such happenings and they present them to the medical profession in the *Journal of the American Medical Association.*

In the first place, these physicians have prepared in legal form a "Consent for Artificial Insemination." This must be signed by both husband and wife, their fingerprints being affixed to the margin.

These consent blanks are signed in duplicate, notarized and witnessed. They are then separated and placed in vaults of separate banks and forgotten unless some legal complication should arise.

The consents legitimatize the child under the present laws of New York state and establish it as the legal heir of the family unit.

sent blanks the man is given a physical examination to determine his sterility—which, of course, has already been established by some physician—and the fingerprint record identifies him as the husband and not as some third person presented by the woman as her husband, in case she had it in mind to deceive her real husband.

This procedure also "acts as a mental binder on the husband in that he knows that he can never deny having authorized the creation of his wife's child," the doctors state.

To protect the donor, or artificial parent, the doctor insists that he deliver his specimen for the test tube to a different address than that to which the woman comes and at a different time.

The simplest method Drs. Seymour and Koerner have employed is to hospitalize both donor and woman during the period in question. In this way the donor has no possible way of knowing who the recipients are and no one can learn his identity by spying.

Notarized permission from the donor's wife stating that her husband may take part in this scientific venture is also suggested. Otherwise the procedure may possibly be construed as a violation of the state laws against adultery.

The surgeon who does the artificial insemination should not later be the obstetrician who presides at the baby's birth, Drs. Seymour and Koerner warn.

The expectant mother should choose an obstetrician who is unfamiliar with the unusual circumstances of the pregnancy. He can then in all good faith make out the baby's birth certificate under the direction of the parents and give the child a document irreproachable in the eyes of the law. This may be a subterfuge, the medical authors say, but it is a necessary one. Never, they warn, must the child be allowed to discover any irregularity in his creation, for this would cause an inferiority complex.

Never under any circumstances should a relative be used as the donor, they further urge. If the husband says he would like his brother to act as donor so that the child might resemble him, this should not be considered. If the mother was informed or later found out who the actual father of her child was, she might transfer her affections to the brother. If the brother's wife was informed or later discovered the truth, she might make trouble. The brother might grow fond of the child and sue for its custody, and a jury might be inclined to favor him.

In selecting a donor, says Drs. Seymour and Koerner, it is a good idea to choose one whose blood group corresponds with that of the husband, as the courts sometimes decide questions of paternity by this means.

A father could of course avoid all legal complications in regard to inheritance of real property by instituting formal legal adoption proceedings, the physicians state. However, this is the last thing he wants to do, as he wishes to conceal the fact of the cross-insemination of his wife.

In the midst of their medico-legal discussions, Drs. Seymour and Koerner pause to state how the test-tube type of paternity may easily strengthen the bonds between legal husband and wife. The mother after bitter years of disappointment over her childlessness admires the broadmindedness of her husband in permitting artificial in-

# THE AMATEUR TELESCOPE MAKER

**Conducted by ALBERT G. INGALLS**

NO crutch is required by the one-legged telescope shown in the present (fourth) edition of "Amateur Telescope Making," at page 144, Figure 15. Until the following communication reached us we knew of nobody who had actually made that telescope. Russell W. Porter of Pasadena, California, now reports as follows:

"Not content with merely suggesting a new and untried mounting for a telescope, as I did in the fourth edition of 'A.T.M.,' I have taken the bull by the horns and made one (Figure 1). Members of the 'Hundred-to-One Shot' Club ($100^{-2}$ Club) recently took it out into the Mojave Desert for a night's try-out. [*Editor's Note:* The Club named has been heard of before, though our resolving power fails to define its exact outlines from this distance. It appears to be a conglomeration of TNs and other highly intelligent people supposedly addicted to things scientific, who trek to various godforsaken places within motor radius of Pasadena, fry steaks, eat smoke and ashes and put up with one another's theories about the secrets of the universe, measure the sun's altitude with sticks and strings to make sure that orb is not getting lost, concoct new mountings, sleep in the sand, sit on cactuses, dodge side-winders, and get all tired out resting up. They do these things well in California.] Surprisingly, it developed no serious drawbacks, and proved at once its convenience as a support for a Cassegrain tube assembly.

"The optical parts are an 8" primary and secondary, contributed by Byron Graves, slightly modified by an aluminum coat applied in vacuo by Dr. Strong. The mirror is about $f/3.5$.

"The mounting is portable, and may be quickly assembled or taken down and packed in a box that goes easily into a car.

"The leg (arm of fork) *A* was hewn out of sugar pine. In assembling, it is slipped over the tapered end of the polar axle *B*, and drawn home with butterfly nut *C*. Likewise, the tube goes on the other end of the leg, but here the connection is the stud *D* and circular track which makes the declination axis.

"The polar axle consists of two parts that telescope, namely, *F* made of 2" Shelby tubing, and *G*, of 1" solid steel rod. The steel point *H*, at the end of the solid shaft, defines the lower (thrust) bearing of the polar axis, the north bearing being merely a cradle of V-block *I*, attached to the two detachable legs *J, J*. With the telescoping polar axle, and open upper V-block bearing, the lining up of the polar axis with that of the earth is easily accomplished on any terrain. The steel point found that a dimple in a boulder (shown in the sketch) made a reliable south bearing.

"Slow motions in Dec. and R. A. have long tangent arms bearing against screws *K* and *L*. The R. A. arm, having a hinge at *M*, can be transferred from one leg to the other, as desired.

"The instrument is completely counterpoised. The advantage of getting rid of one arm of the fork (but at the same time doubling the strength of the other) is in the room thus made available in the vicinity of the gooseneck eyepiece when the telescope is directed to the northern heavens.

"Graves supplied the tube, complete. [Graves, in the picture (Figure 2) is the second figure from the left, under the 'western' hat, who is doing the heavy looking on while several members of the aforementioned club are on their knees, getting the latitude within a mile, by means of shadows, under Porter's guidance and using only a piece of string. Porter reclining.—*Ed.*]

"The only machining on the mounting itself was done on a simple drill press.

"We detected some vibration and, by tapping different parts of the mounting, thought we had located it either in the wooden arm itself or the two legs supporting the V-block. These vibrations can be eliminated by increasing the cross-section of the arm and legs.

"Now that the one-legged mounting has gone through the fire of a Mojave Desert test, and survived, I feel no hesitancy in recommending it to any one who may lack a machine shop but wants a convenient, portable support for his Cassegrain telescope."

FROM time to time puzzled workers have asked us why "Pyrex" mirror disks usually come with a ring on the back which either stands above the rest of the back surface, like *a*, Figure 3, or below it, like *b*; also why the sides of the disks are slightly tapered instead of parallel; and why the face of the disk is usually concave. Many ask why there are bubbles in the glass.

Mere inspection of the disks themselves is likely to leave the worker without the answers, but a few minutes' observation at the shops of the Corning Glass Works, when disks are being molded, would quite readily provide them.

(*1*) *The ring:* The disks are pressed in a cast-iron mold having a cross-section essentially like that shown at *c*. The "gatherer," as the workman is called, tries to pour into the mold just enough molten glass to fill it. Now it is quite easy to fill a receptacle rather exactly with some ordinary liquid, such as water, but not so easy to do it with molten glass. Still more difficult is the "Pyrex" brand glass from which the smaller telescope disks are made, for this has a relatively high melting point—about 2800 degrees F.—and it is impracticable to reduce it to the convenient fluidity of water. Instead, it is "worked" as a thick, slowly crawling mass, the amount poured into a given small mold being better describable as a gob than a liquid. However, the experienced glass worker, even then, can estimate the size of gobs fairly closely—he has been estimating gobs all his life. So he pours in his gob.

Next, this gob man claps on the metal ring *d*, and then down comes the plunger *e*, to force the reluctant molasses-in-January to fill out the mold by means of pressure. Now, if the gatherer's gob was estimated just a trifle too small, we get what is shown at *a*; if too big, we get *b*.

(*2*) *The non-parallel edges of the disk:* These represent the "draw," just as in a molder's pattern. If the metal mold were given a parallel side the cooled disk would be difficult to remove.

(*3*) *The concave face of the disk:* This represents shrinkage of the glass after cooling. Shortly after the plunger is raised, the disk, already pretty cool—for while it is difficult to bring "Pyrex" glasses *up* to

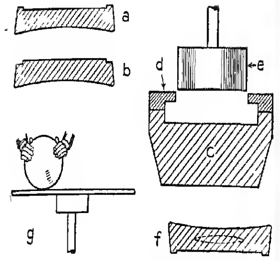



*Figure 3:* The why of it

the temperature where they work easily they drop in temperature with alacrity—is slid out by inverting the mold, and what we now see is a disk that is dark all around the exterior but still has a red hot lens-shaped part in the middle, something like *f*. As the disk, now lying on its back, goes on cooling and contracting, the center "falls," just like an unlucky cake. Now, if this "cake" would only be so kind as to fall *the same amount* in each case, the fall could easily be compensated by making the inside of the mold *c* a bit deeper at the center, thus attaining the desired flat-faced disk. But glass isn't a much more obliging performer than pitch—and you know what that means.

(4) *The bubbles:* In a low-viscosity fluid like water or, say, beer, the bubbles rise rapidly to the surface, but in the viscous molten "Pyrex" glasses the smaller ones cannot make the grade fast enough, and so they get frozen in before they reach the top. A lot of good scientific gray matter in the glass industry has been worn down thin on this old, old problem but the bubbles we still have with us. Even in the much more easily melted crown glass used in fine photographic lenses it is impossible to eliminate them all.

Speaking of these same bubbles, what to do about them when they are broken into in grinding is something else again. Obviously their fragile edges ought to be reamed out, so that fragments of glass will not become detached and cause bad scratches. Just how to do this is something we cannot advise, never having had the experience. If a dozen workers who have actually done it would report what they learned, the published accounts would be useful to the next fellow and the next.

NOW for some of the cussing about ordinary plate glass disks. For years we have heard complaints that these were not truly round; one man claimed his was a triangle. Here is how these disks come to be sub-polygonal. First you have a slab of plate glass. On it the glass worker scratches a circle. Next he puts the slab in a sort of clamp, so that it is held horizontally with an edge overhanging. He grabs a man-sized pair of tongs—about a yard long—and begins rapidly breaking off hunks of glass. In 60 seconds or so he has a sub-angular disk with bulges around its periphery. He takes this to a slowly rotating horizontal metal plate, like *g*, on which a stream of water steadily brings down coarse abrasive and, holding it in his two hands he rapidly grinds off the bumps. He has no gage but his eye, though that is pretty fair. It could of course, be done on a centered arbor, giving a true circle, but then the disks would cost more. Naturally, a truly circular disk

*Figure 4:* Using remote control to regulate the speed of the telescope

neatness. Optically the shape, whether round or the shape of Texas, makes no difference. Mechanically a round disk is not liable to flexure due to its shape, but an irregular shape, if bad enough, may be.

One amateur claimed a disk that wasn't quite round—and they may vary a sixteenth inch or more—caused flexure that altered in different positions of the telescope. He was from Manchuria—and we are from Missouri.

THE Dr. Calder, around whose work Professor Russell's article is built this month, is one of the amateur telescope making fraternity—a former physicist who, after making a telescope, made more, and shifted from physics to astrophysics for good.

PRESENT and former radio "hams" abound among amateur telescope makers and these, as well as others, will take interest in a telescope drive (Figures 4, 6) described by William Silvertooth, 274 Ximeno Avenue, Long Branch, California.

"The driving system to be described was designed in an effort to secure all of the desirable refinements essential to a perfected unit without recourse to the usual complicated mechanisms. While constructed for a moderately sized telescope, the principle is equally applicable to larger instruments where its conveniences would be more readily felt.

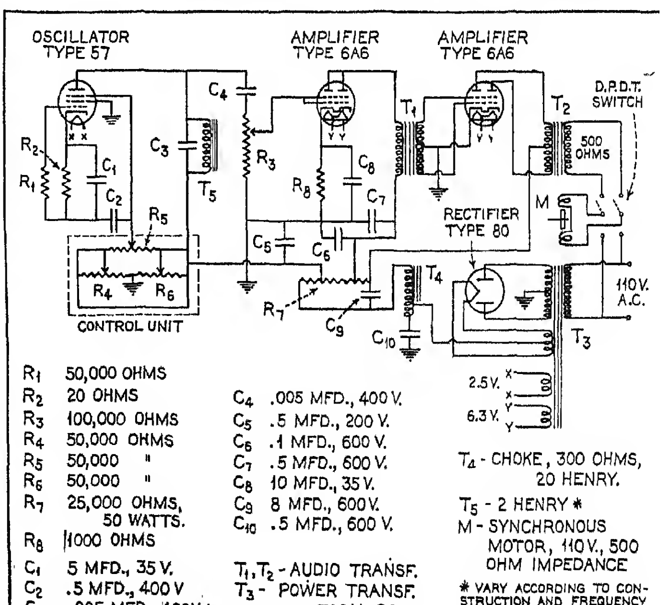
"The gear train has been reduced to the simplest form. It consists of a 100-tooth worm gear connected with the polar axis through a friction plate; the worm is shafted in common with a 144-tooth spur gear which meshes with a 10-tooth pinion on the shaft of the motor. This synchronous motor, which turns one revolution per minute, is available commercially in both 50- and 60-cycle models.

"With such a gear system the polar axis will rotate once in 24 hours when operated on the regular line, the accuracy being a function of the stability of the supplied frequency. By interposing some method of frequency control between the line and the motor, the rotational speed of the telescope may be varied. Numerous complicated systems of motor-generators, tuning forks, pendulums, etc., have been tried; all having the disadvantage of added moving parts and limited flexibility.

"By substituting for such devices an electronic frequency changer, these drawbacks are eliminated; while such decided advantages as remote control, complete flexibility, inexpensiveness, and silent and vibrationless operation are secured. The only moving parts are the control dial and the motor armature.

"The small remote control contains three potentiometers. Two are employed to set the range of frequencies to be covered, as well as the location of those frequencies in relation to the one being altered. The third is employed as the actual control, covering the band as set by the initial dials.

"Considerable experimentation was done



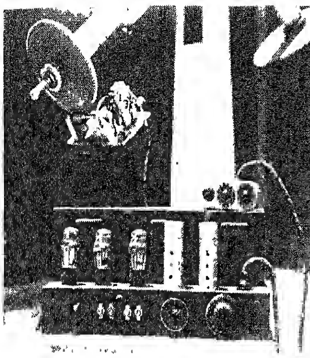


*Figure 6:* Complete driving system

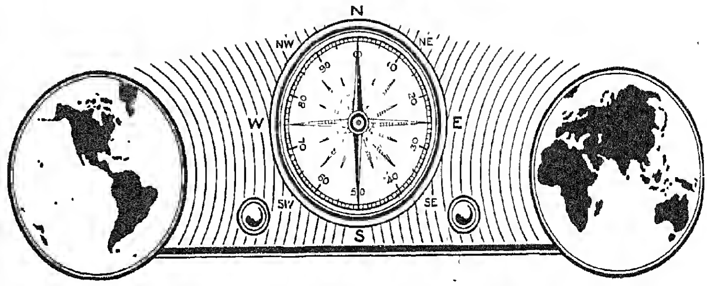
in order to secure a stable oscillatory circuit. The one described and finally decided upon shows no tendency to drift when compared with either the line frequency or harmonics of standard laboratory oscillators. Additional refinements of switching arrangement make it possible to change from the line to the unit from the remote control. Other switches on the unit make it adaptable for various purposes. The circuit was designed by Ed. Sawyer, the gearing arrangement being made by Mr. Edward Lester. Any further information or details of circuit constants will gladly be supplied by the writer."

In further explanation of this drive, Mr. Silvertooth adds the following, in a letter.

"The speed of a synchronous motor is dependent on the frequency (oscillations per second) of the voltage supplied to it. If this frequency is changed, the speed of the motor will also vary. In the described electronic frequency changer this is done by changing the frequency of an oscillating circuit. Variable resistors are employed to do this. The rest of the equipment is merely to amplify the output of the oscillator sufficiently to run the motor. With a different amplifier a larger motor could be used if this were desirable. The condenser $C_3$ and choke $T_2$ must be selected to yield the desired frequency. This is the only part of the device that might require adjustment. It is not necessary to use the fundamental frequency of the condenser and choke; any one of a number of harmonics may be employed.

"Since sending you the description I have completed another driving unit of the same general description, and it functions equally as well as the first refined system."

ABOUT that book—"Amateur Telescope Making—Advanced," more can be said next month than now, as there has been delay due to difficulty in getting proofs back from some of the authors. We begin to think authors are almost as bad a lot as editors, but this is not meant as an insult. The chief difficulty in making announcement of a book in a magazine is that you cannot do it *as of* the time the reader will receive it. As this is written, on Nov. 25, the last remaining author writes from England that the "next ship" will bring his corrected proofs. All the corrected galley proofs must then go back to the printer for alterations. Back come page proofs, again to be read (over 300,000 words). Only then can one say to the printer: "Print, bind, ship." It is a complicated business. Even the above omits most of the slimy




# WORLD-WIDE RADIO

**Conducted by M. L. MUHLEMAN**
Editor, *All-Wave Radio*

## Midget Cathode-Ray Tube

THE typical 1937 all-wave radio receiver employs an electron-ray tube as a visual tuning indicator. With television supposedly hovering in the background, it is not beyond presumption that the radio manufacturer may capitalize on the growing public consciousness of radio-vision by installing cathode-ray tubes in the 1938 receivers, now that a practical miniature tube of low cost is available.

Be that as it may, the new type 913 low-voltage cathode-ray tube of the high-vacuum, electrostatic type, introduced by RCA Radiotron, could well be used in a radio receiver as a visual tuning indicator and at the same time produce the fascinating patterns of the wave-forms of speech and music as they are traced by the finger of the electron beam on the fluorescent screen of the tube. Moreover, when used under the proper conditions, such a tube will indicate the approximate operating efficiency of a receiver and show up faults that may develop in the receiver circuits.

In the meantime, the new midget cathode-ray tube will be of interest to the engineer, the licensed radio amateur, the laboratory worker, and the advanced listener. It will perform all the principal functions of the larger, more expensive cathode-ray tubes, and requires a much lower operating voltage—250 volts minimum, 500 volts maximum. Such potentials are readily obtainable from inexpensive power-supply units of approximately the same type as used in the average radio receiver.

In appearance the RCA 913 is quite different from other cathode-ray tubes. It is constructed like the all-metal receiving tubes except that the end of the metal shell is replaced by a fluorescent viewing screen about one inch in diameter, as shown in the accompanying illustration. It is provided with two sets of electrostatic plates for deflection of the electron beam, similar to the larger tubes. The brilliant luminous spot produced by the beam is a greenish hue.

The RCA 913 is well suited for laboratory work where a large viewing screen is not required and where compactness and portability of the equipment may prove to be an important factor.

With no more than an adequate high-voltage supply with a simple filter, the tube provides an excellent visual indicator for an amateur transmitting station. When properly connected to the transmitter, trapezoidal patterns can be obtained that will immediate indication of improper adjustment. Complete wave envelopes can be produced by the addition of a simple sweep circuit.

The advanced listener interested in the study of the character of radio signals will find the midget cathode-ray tube of great value. A complete and inexpensive oscillo-

New midget cathode-ray tube that holds great possibilities for various applications in radio experimental work. See the text

scope can be constructed and operated in conjunction with the all-wave receiver to show degree of modulation, points of resonance, fading conditions, signal interference, and so on. For that matter, such a unit is a complete laboratory in itself, and can be put to many other interesting uses.

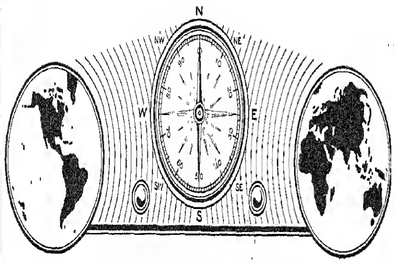
## W2XAF Over London

SOARING over London in an airplane at 250 miles an hour between the hours of midnight and 3 A.M., Harry E. Bowbyes, member of the Royal Air Force, writes the General Electric Company that "out of the dark blue came a sweet voice from across the Atlantic—the Burns sisters singing on a program being broadcast by short-wave station W2XAF." Flyer Bowbyes said he had rigged up a short-wave receiver in his plane and that during the lonesome hours of the early morning thought he would try it. One of the first stations tuned in was W2XAF.

## Crosley 37-Tube Receiver

A SUPER-POWER radio receiver employing 37 tubes, equipped with six loudspeakers, and having a power output from 50 to 75 watts, has been introduced by the Crosley Radio Corporation.

Four chassis are required for the arrangement of the equipment. The first is devoted to the tuning of radio signals and has a continuous frequency coverage from 540 to 18,300 kc, divided into three bands. The second chassis embodies the audio power amplifier. The third chassis furnishes the

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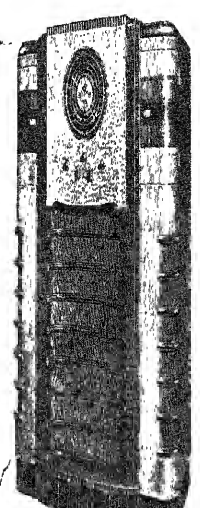


*37 tubes—six loudspeakers*

vides the power for the field coils of the loudspeakers.

One speaker is 18 inches in diameter and is used to reproduce the bass sound frequencies. There are two 12-inch speakers for the mezzo or middle musical range. Three smaller high-frequency speakers reproduce the treble or high-frequency range of the higher notes and overtones.

The receiver is said to have an audible frequency range from 20 to 12,000 cycles. It is equipped with volume expansion, bass compensation, and six-step tone control, in addition to volume control for each audio range—bass, mezzo, and treble. The receiver is also equipped with an automatic tuning system.

## Relief for Short Waves

THE International Broadcasting Union, representing all the leading broadcasting organizations of Europe, has recommended in its proposals for the Bucharest radio conference that a minimum of 10-kilocycle separation be adopted for short-wave stations.

The separation, which is uniformly observed in this country, "is necessary to insure good reception," the union states, and adds: "It is necessary to consider a greater separation corresponding to two or three channels of 10 kilocycles between stations which can be received simultaneously with a field of the same order of strength in the same region."

If such a recommendation is adopted, much of the present inter-station interference in the short-wave bands will cease. Most nations, including the United States, realize that the value of short-wave broadcasts cannot be fully gained so long as the programs are subject to a veritable barrage of heterodyne whistles. It is to the best interests of each country, therefore, that each station be separated from the next by a frequency band sufficiently wide to eliminate the overlapping of carrier side-bands. A separation, or "guard band," of 10 kilocycles has been found adequate in this country.

Our own Federal Communications Commission has not been slow in recognizing taken steps toward cleaning up conditions in this country. A new ruling provides that no United States short-wave broadcast station may operate with less than 5000 watts power and that each station must reduce the frequency tolerance of the transmitter from .03 to .01 percent. This ruling insures reliable operation of each station and, in consequence, more consistent reception of short-wave broadcast programs.

It is interesting to observe that, under the new F.C.C. regulations, stations that have been "experimental relay broadcast stations" are now to be known as "international broadcast stations," the new name being significant of the service rendered. It is the aim of the F.C.C. to place emphasis on the foreign service of United States short-wave broadcast stations and to encourage programs of international scope.

The reference to "international scope" has not been clarified, but it is inferred that the phrase is not intended to imply propaganda.

## Clear Channel, High Power

AMONG important broadcasting recommendations made at the allocations hearing of the Federal Communications Commission, the Radio Manufacturers Association (RMA) strongly urge maintenance of clear channels, high power, and expansion of short-wave broadcasting.

Clear channel and super-power broadcasting were the principal subjects in controversy among broadcasting groups and interests at the Washington hearing. The RMA declared in favor of present clear channel broadcasting as a public service, for removal of present restrictions against increase of power, and that the Commission establish minimum power requirements.

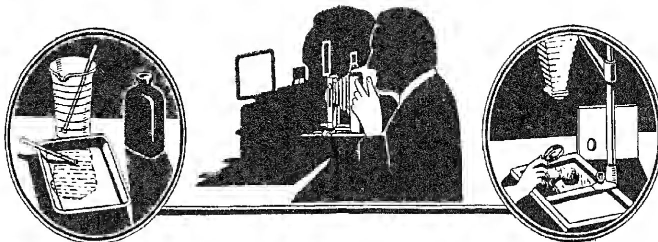
These measures, if enacted, will improve general broadcast reception conditions. Aside from the fact that the "service area" of a broadcast station is increased with an increase of power, there is the added advantage to the listener of a reduced noise background.

## Selectivity and Band Spread

MANY owners of all-wave receivers confuse selectivity with the degree of band spread made available. There is no connection between the two. Selectivity is the ability of a receiver to separate electrically one station from another. No amount of selectivity will permit the complete separation of two stations whose frequencies overlap, as often occurs in the short-wave bands. But a modern receiver, with good selectivity, should be able to pull in one station free of interference from another if the stations themselves are actually separated.

A receiver without band spread *appears* to tune sharply because the stations are crowded together on the dial scale. But this is no measure of receiver selectivity. Another set having ample band spread would appear to tune broadly whereas it might well have greater selectivity than the receiver without band spread.

The band-spreading feature is provided only as a means of ease in tuning. The fact that one station may occupy one or two degrees on the band spread dial scale does



# CAMERA ANGLES

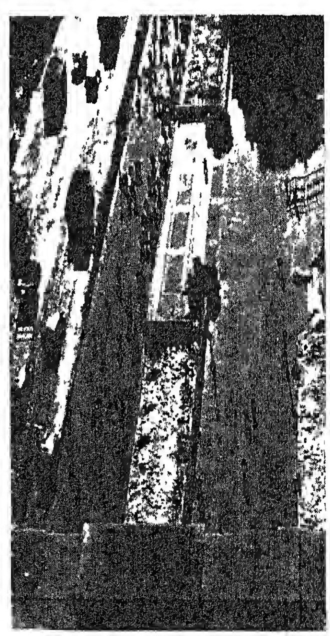
**Conducted by JACOB DESCHIN**

## Winter Photography

WINTER usually means snow pictures and snow pictures mean strong contrasts. To expose for the shadows and let the highlights fall where they may is a rule to be heeded with extreme moderation and in many instances to be ignored. At no other time of the year is the decision in this regard to be reached so carefully as in snow-time; at no other time is overexposure so easy, unless a reliable meter is used. On the other hand, down-right overexposure in order to catch something interesting in the shadows, as in "Looking for Company," in which an ordinary background is allowed almost to disappear in order to record the interest inherent in the lone sparrow on the branch of the leafless tree, seems, to this department, at least, legitimate. After all, rules are only guides; they should not be our masters, else photography would be a sorry thing, indeed, monotonous and dull and completely void of imagination.

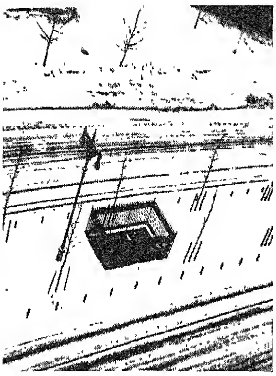
"Looking for Company"

To show the texture of snow is very desirable and if we confine our activities in this connection to the early morning or late afternoon hours, when the lighting is soft and diffused, we can achieve considerable success, provided we choose the right viewpoint to show it off—that is, against the light, —expose fairly correctly and develop with care to prevent blocking-up. "Study in Texture" is an attempt with a 35-mm camera to catch an effect in the early morning. Favorite subjects in this connection are broad expanses of snow "dunes" in the city park, with the trees casting long shadows, a "close-up" of a snow bank freshly fallen and before it has had time to freeze up and harden into lumpiness, the virgin snow on a park bench or window sill. Since snow texture in a photograph depends so much on a fairly close or average-distance viewpoint, exposures made from a relatively high altitude, as in "Deserted," which was photographed from the roof of a six-story building, and "Winter Shadows," shot from the twenty-second floor of a skyscraper, cannot be expected to give more than the impression of snow.



"Winter Shadows"

Snowfall is the silhouettist's paradise. What an opportunity for sharp, black outlines against white backgrounds! Exposing for the shadows offers no problem to him; he measures carefully the strength of the light reflected from the snow and photographs the snow after having arranged his "silhouettes" of trees or benches or what-



"Deserted"

It is this department's opinion that too much stress has been placed on getting texture into snow for the reason that if snow is photographed for itself alone (as it must be if texture is to be achieved) it is simply a matter, as we have said above, of proper lighting and exposure. But what of the many interesting subjects that are met with in a snow setting and that could not adequately be recorded if we exposed for the snow and

"Falling Snow?"

let the shadows take care of themselves? What of birds feeding in the snow, for example? Indeed, there is a time for texture and there is a time for pictures in the snow and while the two may sometimes be reconciled, common sense and the ability to select must decide the issue.

Concerning the often-discussed photography of falling snow, the accompanying illustration, "Falling Snow?" shows what happens when this is attempted at other than a high shutter speed.

## A New Picture Market

AN opportunity on a platter is offered to amateur and professional alike by *Life*, successor to the old humorous journal of that name. Willard D. Morgan, formerly of E. Leitz, Inc., announces that he has been placed in charge of this magazine's picture requirements, and from the announcement it would seem that pictures are about all this magazine will buy. The publication will continue as a weekly.

"The whole purpose of this magazine," writes Mr. Morgan, "is to present the latest information in pictures. . . . In brief, this new magazine will use photographs by the hundred, and they will cover everything did type of picture, pictorial shots, news photos, the strange and the common subject in a new light are only a few suggestions; outstanding cover pictures and photographs in natural colors will also be in demand in large numbers. A booklet of instructions will be prepared later for distribution to all amateurs and professionals interested in this new publication. The magazine will pay for all pictures used and it will consider each photographer as a professional just as soon as he is able to produce pictures which can be purchased for publication."

Mr. Morgan adds that he "will be personally interested in receiving letters regarding the sale of pictures to this new market" by readers of Scientific American and intends to answer all these letters personally and inform the writers about the requirements of this magazine.

He writes that his "job will be to locate photographers in every city who will be in a position to produce pictures for *Life*" and to this end is interested "in obtaining the following information from all amateur and professional photographers for my files":

1. Name and address.
2. Type of photographic equipment available.
3. Time available for photographic work.
4. Types of pictures you are interested in taking.
5. Subjects and places you have photographed.

Also any additional information that may help Mr. Morgan to determine what kind of pictures you are in a position to offer *Life*. Mr. Morgan should be addressed care of *Life Magazine*, 135 East 42nd Street, New York, N. Y.

## Casual Models

THE accompanying "Gamin" and "In Pensive Mood" are presented as reminders that the streets are full of good youthful subjects who can without great difficulty be persuaded to come in and have their pictures taken. It was this department's good fortune one day to find four interesting Negro boys in a theater lobby in animated debate as to ways and means of getting enough cash together to get by the ticket chopper. Although time pressed and there were many things to do, the impulse to ask them to pose for this

"Gamin"

department's camera was irresistible and, since a cash offer was made, they accepted without a moment's hesitation.

With flood and spotlight and a fast lens to catch the right moment, it was fairly easy to get a group of unusual portraits which would not be possible under the condition of lighting and locale in which the boys were found. There must be a few of our fellow-hobbyists who have at one time or another had the experience of coming across an unusual type and wished that they could get a shot under proper lighting conditions. While granting that children are easier to persuade to come inside for a picture, adults are not as difficult in this regard as might be supposed. There is always a tactful way of putting it over, depending on the person approached, and there are few, barring inability to spare the time or down-right incurable modesty, who will refuse a well-addressed invitation.

## We are Hung

THOSE of our readers who had the charity to see something worth while in our picture "Leisure" in the September 1936 issue of this department may be interested to know that it was accepted for hanging, under a changed title ("Sunday"), in the National Salon of Photography in New York City in November under the sponsorship of the Oval Table Society of that city.

Many fine prints were submitted by some of the best workers in this country and from the relatively small number accepted for hanging it would seem that the judging was quite severe. Prints were submitted in two sections, the pictorial and the technical, the percentage of acceptances in the former being 14 percent, that in the latter 45 percent. The total number of prints submitted in both groups was 2070, of which only 351, or 17 percent, came through successfully.

## All-Metal Enlarging Easel

FOR those experiencing "easel trouble," a new all-metal enlarging easel has recently been introduced in sizes 8 by 10 inches and 11 by 14 inches. It is called the Bee Bee and its distributors declare it to be precise and substantially built, offering "complete protection against the annoyances heretofore experienced by photog-

justed simultaneously with one lever, and extremely wide, sliding clamps offer rigid support for the 1½-inch masking bands.

## The Man Behind the Camera

It may prove monotonous to some of our readers to hear so much about the fact that it isn't the camera, but ——. Nevertheless, we cannot resist the temptation to report that we have it on good authority that Cecil Beaton, the famous English photographer, who created those remarkable photographs for *Vanity Fair* and is now doing the same thing for *Harper's Bazaar*, did most of his pictures for *Vanity Fair* with a 3A Kodak and turned to a professional 8 by 10 studio camera only after much urging and persuasion. Any comment we might make on this bit of Walter Winchellism would be too obvious, so we shall let it stand as it is.

## Market Guide

A new guide to picture markets is called "The Universal Photo Almanac and Market Guide" which, in addition to other useful information, contains a market guide which lists "thousands of newspapers, magazines, syndicates, calendar manufacturers, and others who buy free-lance pictures."

## Viscose Squeegee

A viscose squeegee for wiping surface water from negatives to permit quick drying without water spots has been introduced by Fink-Roselieve Co., Inc. This company, which has made life easier for the darkroom worker by bringing out a concentrated acid liquid hypo called Fixol, a concentrated universal developer called Quinolin, and an exposure compensating fine grain developer called CDX, offers in the viscose squeegee a very convenient darkroom tool. It consists of a bent cadmium plated handle on each end of which is a section of viscose sponge. By squeezing the handle the sections of sponge may be used to wipe the wet film strip.

## Over-Printing

One of our readers has chided us for not having divulged sooner the trick of over-printing a negative in order to pro-

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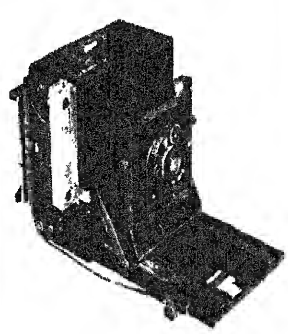
duce a picture strikingly different from that produced by printing the negative by normal exposure. We thought and still believe that most of the followers of this department are already familiar with this procedure, of which one of the most usual examples is that of over-printing a sunset scene to make it look like a moonlight picture. "Manhattan Monolith" is our contribution in this field—the negative was over-printed to provide a semi-silhouette against a fairly bright sky.

## Exposure Meter

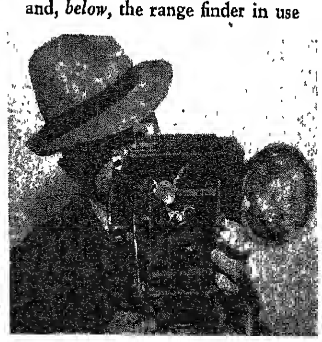
AN inexpensive exposure meter based on scientific measurements of light intensities for the various months of the year, the different times of day, weather conditions, subject-matter, and speed of the film used, is now on the market. Known as the "Quick-Set" Meter, it is only 4 inches long by 1½ inches wide by one eighth of an inch thick. By moving one slide to the position corresponding to the speed of the film being used and another slide so that the mark corresponding to the month and hour is opposite the mark indicating existing light conditions, the meter instantly shows the full range of shutter speeds with the corresponding diaphragm openings.

## Range Finder for Graphic

"AMATEURS and professional photographers who use larger film and plate cameras need no longer envy the speed and accurate focusing facilities of the miniature camera," writes Kenneth M. Swezey, of Brooklyn, N. Y. "A coupled range finder, just developed for the Speed Graphic by the Kalart Company, may be attached in a few minutes by anyone handy with tools, and may be quickly adjusted for lenses of any focal length. In use, the photographer merely sights through the range finder and adjusts the regular focusing screw. When the two images of the object to be taken coincide, he may press the release, confident that the object is in sharp focus."



New range finder on Speed Graphic, and, *below*, the range finder in use



## THE SCIENTIFIC AMERICAN DIGEST

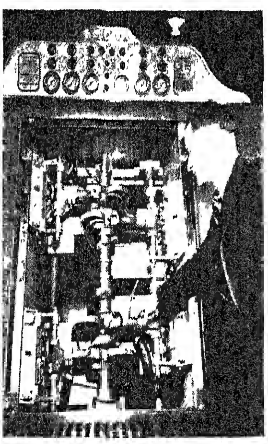
(*Continued from page* 41)

semination. The husband, in case he is anxious for an heir, is happy that his wife will resort to this unusual step to make up for his deficiencies.—*Science Service.*

### INDUCTION SPEEDS HARDENING OF METAL SURFACES

ELECTRICAL induction now hardens metal surfaces in a new process which definitely will make tremendous economies possible in a wide diversity of industries. The development, announced to the trade as the "Tocco Process" by the Ohio Crankshaft Company, was hailed in automotive circles as a great forward step which will quicken production methods and improve the quality of crankshafts for all kinds of engines. The method not only reduces "hours of surface hardening time to seconds but produces a scientifically regulated, exact result—superior in many ways to the surface produced by the old, wasteful, furnace treatment formerly used," it is claimed.

For the Tocco-hardening, a high-frequency current at high voltage is transformed into low voltage with high amper-



Set-up for surface hardening only the wearing parts of a crankshaft

age. This current passes into inductor blocks which surround but do not actually touch the bearing area it is desired to harden. The inductor block current induces a current in the surface of the metal, the induced current being the heating factor.

When the area to be heated has been thus subjected to an accurately controlled, high-frequency current for the correct length of time, the electrical circuit is opened and simultaneously the heated surface is quenched by a spray from a water jacket built into the inductor block. When all the main, intermediate and pin bearings are hardened, the entire shaft is drawn at a low temperature to remove strains. Then a final grind completes the shaft.

The combination of instantaneous pressure quenching and a split-second heating cycle produces a surface hardened zone blending gradually into the core with no sharp line of demarcation and consequent-

The steel to be used in a crankshaft which is to be Tocco-hardened must be one which passes the usual inspection tests and in addition should be of the fine-grained type. After forging, the crankshaft is allowed to cool slowly, this alone producing the necessary normalizing. Then without further normalizing or heat treating, it is machined, radial oil holes drilled, and the journals rough-ground. The final grinding operation follows the surface hardening.

The Tocco process has already been adopted by a number of outstanding manufacturers.

### DEPROTEINIZED RUBBER

AS a challenge to the valuable properties of synthetic rubber-like materials, methods have been found which materially improve the shortcomings of natural rubber. One of the most important of these is the so-called deproteinized rubber from which small amounts of naturally occurring proteins have been removed in its preparation.

Vulcanized natural rubber has the unfortunate failing of absorbing moisture and thus altering its electric characteristics as an insulating material for cables. By removing the protein from rubber before its fabrication this defect is overcome. In discussing the new type of rubber, Boggs and Blake in a recent issue of *Industrial and Engineering Chemistry* state: "Besides the obvious and primary use of deproteinized rubber in electrical insulation exposed to water, there are other possibilities for its practical application. A definite part of the characteristic odor of rubber goods is due to the raw rubber itself. By removal of protein and by judicious use of compounding agents, entirely odorless articles may be secured. Undoubtedly the public will soon demand odorless rubber toilet goods.

"The physical properties of vulcanized rubber are seriously impaired by absorption of water; tensile strength, tear resistance, and abrasion resistance are decreased materially. For rubber compounds which must maintain these properties under more or less continuous exposure to water (particularly warm or hot water), deproteinized rubber is the only proper ingredient.

"Many surgical rubber goods need to be sterilized repeatedly. Ordinarily the life of such articles is limited. The use of deproteinized rubber will be effective in prolonging their service.

"Ebonite is usually resistant to water absorption, but, when the water is warm, absorption may be a serious consideration. Deproteinized rubber overcomes this objection."—*D. H. K.*

### AIR PIPE FROM WINDOW HELPS PNEUMONIA PATIENT

A SIMPLE, inexpensive substitute for oxygen in treating cases of pneumonia, tuberculosis, or even advanced heart disease has been devised by Dr. J. E. Crewe of Rochester, Minnesota, and reported to the American Medical Association, states *Science Service*. Dr. Crewe's apparatus brings gently moving outdoor air to the patient who, because of problems of transportation or expense, cannot have the benefit of oxygen treatment.

The apparatus consists of a pipe three

the patient's face to the window, where it is fitted to a small blower attached to a board that fits beneath the raised window. A hole in the board admits outdoor air which the blower wafts gently to the patient's face. In homes where electricity is not available to operate the blower, an elbow can be fitted to the window end of the pipe to catch the prevailing wind.

In very hot weather Dr. Crewe adds to this simple apparatus an automobile hot water heater with cold water circulating through it, which cools the air. An even simpler variation of this cooling device is to direct the spray from a garden hose past the inlet of the pipe.

"Considerable experience over many years," says Dr. Crewe, "has convinced me that, by the methods described, most patients can be given all the oxygen they require, in nature's own mixture. Recently the apparatus was exhibited at the meeting of the Minnesota State Medical Association and attracted favorable interest, particularly among rural practitioners."

## Alcoholic Drinks from Citrus Fruits

IN seeking ways to use ripe fruit from the citrus groves of Florida, methods have been developed by the Citrus Products Station of the United States Department of Agriculture for making wines, brandies, and cordials, both of new types and of varieties similar to products of grapes.

In making wines the extracted juice with the addition of sugar (1½ to 1¾ pounds per gallon) is fermented at about 60 to 75 degrees, Fahrenheit. This requires cooling when the fermentation is active to prevent too high a temperature. The product, after filtering, is a dry wine with a more or less musty, harsh flavor which does not improve with aging. It can, however, be made palatable by the addition of enough dextrose or sucrose to give a final sugar content of 3 to 5 percent. Such a wine resembles a sauterne and contains 13 to 14 percent alcohol by volume. To make a wine of sherry-like flavor and color, citrus spirits are added to bring the alcoholic content up to 18 to 22 percent and a larger proportion of sugar is added 17 to 10 percent). This fortified wine, after heating for about 60 days at 125 to 130 degrees, Fahrenheit, in plain oak barrels, has a flavor and color resembling sherry.

For the preparation of spirits and brandy, sugar to the extent of about one pound per gallon is added to the juice before fermentation to yield a wine of about 10 percent alcohol. This wine is separated from the yeast before distillation and the product is aged.

Neither grapefruit nor orange brandy has an aroma or taste suggestive of the fruit of origin, although some tasters were able to detect an orange flavor in orange brandy. Grapefruit and orange brandy may be distinguished from one another; the former possesses a characteristic aroma and taste difficult to describe accurately. By adding sugar and various fruit oils to the distilled spirits, pleasing cordials are made. —*D. H. K.*

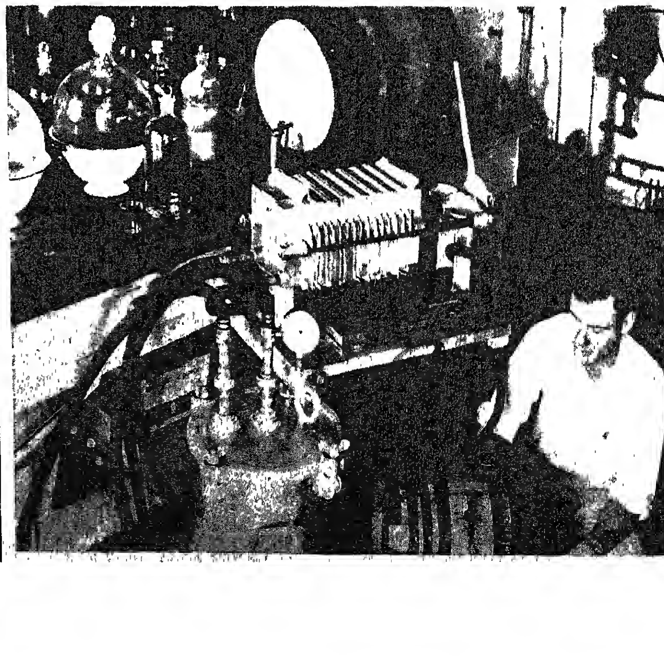
### AUTO DEATHS

TWO members of the Chicago Board of Health have pointed out that it is illogical to compute the auto death rates of a city according to the population of that city. They believe—and it seems most sensible—that auto death rates should be based upon auto population of the city in question.

## Prefabricated and Glued

IN the quest for more, better, and cheaper houses for millions of Americans, a distinct need has been felt for a prefabricated type of housing in which much of the material can be put together in standard factory-made parts by mass-production methods, to be followed by speedy and efficient erection on the site.

That wood may be as readily adapted to such a system as other materials has been demonstrated in the system of all-wood prefabricated house construction developed by the U. S. Forest Products Laboratory at



Joining two window units of prefabricated glued wood. *Right:* Drawing of units used in the system

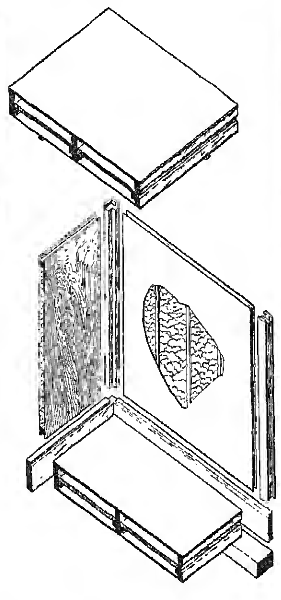
Madison, Wisconsin. Houses constructed experimentally there in connection with the Forest Service wood utilization research program are built up of prefabricated wood unit panels four feet in width and up to 15 feet in length. All panels utilize the "stressed covering" principle, long used in aircraft construction to combine strength, rigidity, and lightness; that is, plywood sheets forming the panel faces are glued with moisture-resisting glue to both sides of the structural framing and thus become a definite part of the load carrying system instead of being an additional load on the supports as in ordinary construction. In this way the framing members can be materially lightened without any sacrifice of strength or rigidity. Joists, for example, have been reduced in height from the conventional ten inches to six inches.

The outer wall panels, by utilizing effectively the strength of the exterior and interior plywood, are 2¼ inches thick instead of the customary wall thickness of six to eight inches. Secure but easy-fitting joints are provided by upright mullions with double grooves to receive the edges of the inner and outer plywood. All panels are insulated—the wall, roof, and lower floor panels primarily against heat and cold, and the partitions and floor panels between stories against sound. All necessary electrical wiring and outlets for servicing the house can be built into the units. The entire system is being developed with a view to quick and ready assembly on the site.

Alternative to the softwood plywood coverings on the standard panels, hardwood finish surfaces can be applied to both floor and wall panels on the interior and paint can be used on walls or ceilings. Either casement or double-hung windows can be used and a choice may be made between the modern flat roof or the conventional pitched roof.

The fact that the system utilizes standard parts does not mean that any two houses so built must be identical in design and appearance. By interchanging various units, different conditions can be met. The use of standard factory-made parts does not mean "standard" houses identical in every part. Prefabricated houses of widely different designs can be built with the same standard panels, provided a few minor changes are made. Industrialization of all-wood housing would substitute prefabricated wall, floor, terials, timbers, sheathing, siding, rafters, lath, and plaster.

Although houses produced according to the Forest Products Laboratory's system of prefabrication are not in large-scale production at the present time, the principles have been adopted in the rapid erection of



low-cost houses, and it is understood that a number of manufacturers are preparing to launch the production of the essential units and the development of accompanying plan services.

### PRODIGY

**A POOR American country plant that went abroad and came back to make good in a big way, the tomato has grown from a 13.9-million-bushel crop in 1915, to one that reached over 17.5 million bushels in 1935. Much of the increase was due to the development of disease-resistant tomatoes by our Department of Agriculture.**

## TIMBER BALANCE

FIGURES often quoted to show that America is using up timber resources several times as fast as they are being regrown, were called in question by John B. Woods of the Society of American Foresters, in an address before his colleagues in Washington, D. C. Changes during recent years, he declared, have gone far toward bringing timber production into balance with timber consumption.

The changes involve both an increase in tree growth and a sharp decline in timber use, he said. The new approach to a balanced state is of post-depression date.

"To compare growth and drain on the basis of 1929 and prior years is to cling to the bad old days," Mr. Woods contended. Consumption declined abruptly from a five-year average of 36 billion feet of lumber to 16.4 billion for the next five-year period.

"Total forest drain for the period 1929-1934 is estimated by Smith in the N.R.A.

The same report carries an estimate of growth for the same period of 8,900,000 cubic feet.

"We recognize that production and loss at the old rate put too great a burden upon our growing capacity. But reduced consumption and increased effectiveness of protective measures have put us practically in a state of balance. The job now is to complete the extension of management to all our lands—both public and private—and build up our productive capacity."

The accelerated re-growth of our timber is a tri-regional affair, Mr. Woods stated. In the still unexhausted Northwest, lumbermen have at last learned the lessons of more conservative cutting, better protection against fire and other natural agencies of destruction, and provision for replacement on cutover lands.

Instead of becoming a barren waste of treeless flats and hills, the South "in two decades has become a potential yellow pine farm, now growing upon half of its pine lands (according to Inman Eldredge) 18,000,000 cords of wood each year. As this great plant swings into production, as the small trees become big ones, the annual yield of sawtimber and pulpwood may exceed in volume the yearly output of old-growth pine in the old days."

The Northeast, Mr. Woods continued, is growing more timber than is being cut. Only in the North Central and Lake States region does growth lag behind depletion.

A brisk building boom, such as is now apparently getting under way, might put Mr. Woods's optimistic calculations to a severe test. On the other hand, more economical use of lumber through recent technological advances could do something toward offsetting an excess demand.

At any rate, it is something of a novelty to hear a note of cheerfulness out of the tall timber, after so long (and justified) a winter of gloomy alarm.—*Science Service.*

### FARM PONDS

**THAT a water hole for cattle must have considerable depth is indicated by the fact that in the five summer months 200 head of cattle will drink nearly an acre-foot of water—352,850 gallons—at the rate of about 10 gallons of water for each animal daily.**

## We Chew Far More Than Our Ancestors

THE charming girl who gnaws a ham bone at the dinner party is not being sensibly primitive. Giving the teeth this sort of hearty work-out is not done in primitive society. So the Arctic explorer, Vilhjalmur Stefansson, declared in an address at the annual banquet of the American Dietetic Association, *Science Service* reports.

"Between the dentists and the Fletcherizers, we chew today far more than our primitive ancestors," he stated. Dental reasoning, he said, has gone astray by assuming that the Eskimos, with their fine, healthy teeth, would chew at least as much as we. Then the argument is built up by picturing Eskimos as extraordinary chewers.

way illustrated by the charming girl, they developed and retained excellent teeth through much biting and chewing of tough and coarse food." The point overlooked, he continued, is that primitive people have had tools since Stone Age days, and carnivorous primitives have one single method of handling meat, practically everywhere in the world.

The proper primitive way of eating was then shown by the explorer, who has lived for years among Eskimos, eating their meat diet: "You take a good-sized piece of meat in your left hand and a knife in the right," he explained. "With your front teeth you nip lightly into the edge of the piece, just so you get a good hold, and then you cut in front of your lips. This piece of meat is not likely to be larger than the one you cut with knife and fork when you dine politely on a sirloin."

In actual fact, Eskimos chew their food less than almost any other people, said Mr. Stefansson, and their native meat diet does not massage their gums with coarse food. Yet not one cavity has been found in any tooth of any Eskimo who died before his food was Europeanized. The Eskimos are the only people known, past or present, who have this 100 percent record of no decayed teeth.

The popular belief that Eskimos chew skins a great deal in preparing them for clothing, thus getting dental exercise, was declared "greatly exaggerated." Attributing the Eskimo's good teeth to his exclusively meat diet, which includes many parts of the animal not featured in civilized man's order of meat, Mr. Stefansson said: "All deficiency diseases seem always absent from people living wholly on meat. In view of much discussed theories it is well to specify that certainly there is never a case of scurvy and almost certainly never one of rickets. Tooth decay is absent, pyorrhea is rare or absent. Teeth when ground down, as by sand in dried meat, seem never to wear wholly down to the pulp so as to result in alveolar abscesses."

Cancer has probably never been reported from Eskimos still living on their native food, the explorer commented.

It is a reasonably sure conclusion, he declared, that "you can be healthy, and live at least the Biblical three score and ten, on a vegetarian diet, on a meat diet, or on a combination of the two."

## Useful Products from Fungi

MICROSCOPIC fungi of certain varieties produce gums described as stringy, creamy, gelatinous, pasty, doughy, rubbery, leathery, or crusty, which may be important as industrial materials. These products of fungus growth have been used in Germany to make a leather substitute and are suggested as binders, adhesives, coating agents, and oil- or grease-proofing media for the cellulose and rubber industries. "The value of these materials in the manufacture of animal feeds has been repeatedly demonstrated," according to J. R. Sanborn writing in *Industrial and Engineering Chemistry.* "Positive evidence is also accumulating which points to their peculiar adaptability to human nutrition and food preparations. Results obtained suggest unusual applica-

for valuable chemicals. It is even possible to develop certain specialty articles which may be rendered particularly desirable because of the activities of micro-organisms. Several kinds of low cost raw materials are available for the cultivation of these organisms such as waste sulfite liquor, molasses distillery slop, cereal mashes, slop from starch manufacture, wood residues, and corn syrup." These food uses are quite aside from industrial applications which seem to offer important possibilities.—*D. H. K.*

## So That's The Reason!

MOST persons who are nearsighted or have astigmatism get themselves eyeglasses to correct the visual defect and go unhampered about their business. These rather common defects, however, are held responsible for some of the vagaries that puzzle the ordinary viewer of modern art.

How nearsightedness or astigmatism in the artist's eyes can make him draw or paint pictures that look queer (eccentric?) to the rest of us is explained by a Los Angeles eye specialist, Dr. Lloyd Mills, in a report to the scientific journal, *Archives of Ophthalmology*.

What we see, he explains, is a combination of images produced by the central part of our eye-lenses and the peripheral or outer parts of them. In order to draw a picture of things as we see them, the artist must preserve the normal proportions of these two kinds of sight in his drawing. This is particularly so since it is the peripheral sight that is most sensitive to color. When the artist doesn't have normal vision, his pictures may appear "queer."

Dr. Mills first became interested in the effect of eyesight on art when an artist came to him for treatment. This man produced paintings which were remarkable for fine use of color, but the drawings were sometimes distorted. This turned out to be due to astigmatism, but unfortunately, when glasses were supplied that corrected the astigmatism, the artist had trouble in getting the color effects with which he had previously had so much success.

Short-sightedness, a condition found particularly among the educated classes, is especially frequent among artists, and has much effect upon their drawings. In short-sighted individuals, the acuity of vision with the central part of the eye is decreased, and they are forced to use that of the edges of the eye. This, thinks Dr. Mills, accounts for the work of Cezanne, Renoir, Gordon Craig, and George Grosz, the cubist. Pissarro had repeated abscesses of the cornea of the eye, and Van Gogh and Gauguin had mental diseases, which accounts for their drawings' eccentricities.—*Science Service.*

## 16-Millimeter Color with Sound

A 16-MILLIMETER projection print that measures up in respect to sound, color, and quality of picture to standard 35-millimeter film, and may be produced at a cost as low as that of black and white, has been developed by the engineers of the Motion Picture division of the Cinaudagraph laboratories at Stamford, Connecticut, working in co-operation with Mr. George Ductions Inc., a subsidiary of Electrical Research Products, Inc.

The new print is made from standard negatives, taken with standard camera equipment and by existing color methods including Bi-pack. Hence, any 35-millimeter standard negatives in color or black and white can be duplicated and reproduced with the utmost fidelity. No departure from existing methods in the taking of negatives is required. The entire story is in the printing of the 16-millimeter positive.

This new projection print is made on standard raw stock now universally used in making black and white duplicates. Two printers are required, one for the sound track, which is printed full size by contact; the other for the picture, which is reduced in size.

Projection is made by a portable projector through duplicate lens with filters for color; and a single clear lens for black and white. The change from black and white to color takes but a few seconds.

**PETROLEUM PERFUME**

**ALTHOUGH to the average person petroleum means gasoline and lubricating oil, it is a large source also of candles, chewing gum, drugs, perfumes, paint, preservatives, printing ink, cleaners' solvents, waterproofing, alcohols, anesthetics, and so on.**

## "Not to be Interpreted . . . . . ."

IN the cerebral cortex of the orang-utan, of Borneo and Sumatra, are what may be the first rudiments of the brain structure of speech. Such is one of the findings of Dr. Cornelius J. Connolly, professor of physical anthropology of the Catholic University of America, who has just completed an intensive study of the cortical patterns of approximately 50 species of primates from lemur to man represented in the primate brain collection of the Smithsonian Institution, the largest in the world, which has been assembled by Dr. Ales Hrdlicka.

Actual speech, so far as known, is an exclusive accomplishment of human beings. It requires not only the ability to make finely differentiated sounds but the ability to associate them in the memory with objects, ideas, and emotions. This associative process is believed by many neurologists to be centered in a part of the cerebral cortex known as Broca's area. It is found in both the right and left frontal lobes of the brain in regions marked off from the rest of the cortex by well-marked depressions known to anatomists as the "inferior frontal sulci."

Depressions which can be identified with these sulci appear for the first time in the entire primate series, Dr. Connolly finds, in the cortex of the orang. Nature has, in a sense, "staked off" a lot upon which the vast structure of speech eventually will be erected. There is no evidence of such a separation in the gibbons whose brains were studied by Dr. Connolly. It appears, even more notably than in the orang, in the gorilla and chimpanzee.

None of these three higher apes, of course, has the gift of speech, as the term is under-

ever have. Dr. Connolly's finding must not be interpreted to mean that the anthropoids themselves are in the process of evolving into speaking animals.

The orang and the two higher apes apparently have stopped just on the threshold of speech, insofar as the surface pattern of the brain is concerned. They have the cortical material probably necessary for voluntary larynx and tongue movements, but the issuing sounds are not hooked up and systematized with memories.

**ROADS**

**THE total road mileage of the world is 9,268,397, or one mile of road to every 5.3 square miles of the total land area of 49,411,882 square miles in the world. The United States has one mile of road for every square mile; Japan, one for each 0.2 square mile; France, one to each 0.5; United Kingdom, one to 0.5; and Germany, one to 0.8.**

## Biological Inhibitory Rays

AT the red edge of the invisible in the spectrum there is a narrow band of light waves which have a powerful and hitherto unsuspected biological inhibitory effect. This discovery, announced in a joint paper by Lewis H. Flint, of the Department of Agriculture, and E. D. McAlister, of the Smithsonian Institution, came about as a result of further studies of the germination of dormant lettuce seeds when exposed to radiation.

Previous studies by Dr. Flint had demonstrated that such seeds could be made to germinate by exposure to red, orange, and yellow light, and inhibited from germinating by irradiation with green, blue, and violet light. The inhibitory effect was general for this upper end of the visible light spectrum, but reached its greatest intensity at wavelengths of about 4200 and 4800 angstrom units in the blue-green region. At the same time studies at the Smithsonian Institution had demonstrated that the green-blue-violet region was in part responsible for the curious phenomenon of bending toward the light, called phototropism, by inhibiting the growth of the plant shoot on the side radiated by those wavelengths. Here also the greatest effects were found in the two regions of 4200 and 4800 angstrom units.

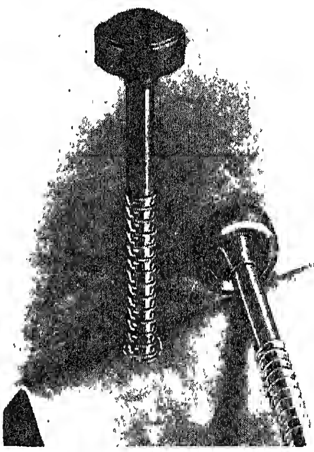
These two regions thus appeared to be of fundamental significance in the complicated relationship pattern between light and biological activity. The discovery of an inhibitory wave band, so far as the germination of lettuce seeds was concerned, more powerful in its effects than the entire green-blue-violet end of the spectrum, came as a complete surprise. This band lies around the critical wavelength of 7600 angstrom units, at just about the point in the red where light ceases to be visible to the human eye.

Ordinarily its effect would be masked by the stimulating effect of the wavelengths surrounding it, especially in sunlight. Perhaps fortunately for vegetation—although strated only with lettuce seeds—the solar radiation in this neighborhood is greatly reduced, owing, it is believed, to its absorption partly by oxygen in the atmosphere of the sun and partly by water vapor in the atmosphere of the earth. Notwithstanding this absorption, however, the energy of solar radiation at this point is large.

Further studies of the possible effectiveness of this region in respect to the germination of other seeds and in respect to other phases of light sensitivity now are in progress.

## Lead Head Nail Doesn't Pull Out

THE new Anchor lead headed nail for galvanized roofing, recently introduced by the W. H. Maze Company, is said not to draw out or work loose, thereby eliminating a common trouble. To gain holding



Lead heads and anchor rings

power, this nail employs the well-known principle of an anchor, the anchors being arranged in rings about the shank as illustrated. The manufacturers point out that this principle, on a lead headed nail, is superior to a screw because it does not twist the head loose and cannot twist out backwards.

## 200 New Plants Patented Since 1930

DESPITE the fact that over 200 plant patents have been granted by the United States Patent Office since such patents on flowers, fruits, and vegetables became legal in 1930, the field of patented plants is virtually untouched. Material prepared in connection with the Centennial Celebration of the American Patent System shows this fact as a logical conclusion, according to *Science Service*.

Here are some of the future possibilities of the effect of plant patents on everyday life:

1. Forest trees grown as an annual crop the same as oats and potatoes.

2. Oranges and bananas grown outdoors in Maine.

3. Apples and peaches six inches in diameter.

Such apparent fantasies appear remote at the present time, but much less so than the idea of the radio or airplane seemed to th

present patent system was just beginning. Queen Elizabeth, it is disclosed, granted what were virtually the first plant patents—except in name—in the famous monopolies given to favored individuals for exclusive rights to flax, hemp, currants, and medicinal and dye plants.

In the early American colonies, monopolies of any form were extremely unpopular. Most of all the dislike was centered on any plant which was considered the gift of nature for all to use as they liked. No one, at that time, foresaw possible research and invention aimed primarily at bringing new and different plant forms, intentionally and for profit. Thus agitation for plant patents continued from 1868 until 1930 before it was finally enacted into law.

Here are a few of the patented fruits, flowers, and vegetables which you can buy today: Apple, apricot, avocado, blackberry, carnation, cherry, chrysanthemum, dahlia, gardenia, gladiolus, grass for golf greens, grape, grapefruit, peach, pecan, plum, rose, strawberry, and waterlily.

## One Motor for German Submarines

HECTOR C. BYWATER, the naval correspondent of *The Daily Telegraph*, London, has recently reported development in Germany of a new propulsion unit for German submarines which obviates many of the dangers hitherto present in submarine operation. This new motor operates on the surface on the Diesel compression-ignition principle, but when submerged it is operated by hydrogen and oxygen. The most quickly recognized advantage of this is that the storage batteries, which often constitute one third the tonnage of a submarine, are no longer necessary. Added to this is the fact that the danger of generation of chlorine gas, caused by ocean water seeping into the batteries, is removed.

The motor is driven on the Diesel principle using oil fuel while the craft is on the surface. But these motors also drive dynamos, which, in turn, generate current for working a high-pressure electrolyzer. This apparatus breaks distilled water up into its chemical constituents—two parts of hydrogen to one of oxygen. These gases are stored separately in bottles at high pressure and are used for operating the motor when the craft is submerged.

## Pocket Planet Broad Jump Records

LET us consider two approximately spherical bodies, the earth and a ball weighing one pound. So long as the ball is at the earth's surface it will weigh one pound.

Let us next suppose we could take the ball out to the moon. Since the moon attracts bodies at its surface with a force only one sixth as great as does the earth, the ball would weigh one sixth of a pound. If we could throw the ball 100 feet on the earth, we could throw it 600 feet on the moon with the same effort.

The moon's low gravitative power would affect us in a way similar to the effect on the ball. If on the earth we were counted among the first-class broad jumpers who can make a running broad jump of 25 feet, then, assuming equal speed at the take-off, we could jump six times as far, or 150



The case of the high jump is not disposed of so easily. In popular books on astronomy one sometimes reads that if a man could jump over a bar set at six feet on the earth he could clear a bar set at six times that height, or 36 feet, on the moon. This statement is not correct. If we watch a high jumper on the earth we will see that when he is above the bar his body is practically horizontal. This means that his center of gravity is not over seven feet above the ground when clearing a bar set at six feet. When he is leaving the ground the center of gravity of his body is already about three feet above it. In making the jump, therefore, he has raised his total weight only four feet. His jump, *as measured*, is, therefore, about two feet in excess of the height through which he raised the center of gravity of his body. On the moon, therefore, he could clear a bar at 6 times 4 plus 2, or 26 feet, and not the 36 feet which is often given.

Many of the asteroids are probably not over eight miles in diameter, or one one-thousandth the diameter of the earth. If one of these had the same density as the earth the value of its surface gravity would be the or one one-thousandth. If we could be transported to such an asteroid and live we would have most extraordinary experiences. For example, a high jumper who could clear a bar at six feet on the earth (4 plus 2) could rise to a height of 1000 times 4 plus 2, or 4002 feet, on the asteroid. On the earth such a jumper is off the ground about one second, while on the asteroid he would be off the ground 1000 times that long, 1000 seconds or 16.7 minutes. He would practically float upward for half that time and downward during the other half.

A broad jumper who could make a jump of 25 feet on the earth would have a still more thrilling experience. Assuming the same speed at the take-off, the surface gravity of one one-thousandth would enable him to jump 1000 times as far, or 25,000 feet. Since the asteroid is only eight miles in diameter this means about one fifth of the circumference of this body. At the height of the jump he would be about 3000 feet above the ground. For spectators at the take-off, the jumper would disappear over the horizon long before he landed.—*Prof. E. A. Fath, of Carleton College at Northfield, Minnesota, in Leaflet 94 of the Astro-*

# LEGAL HIGH-LIGHTS

## Patent, Trademark, and Related Legal Proceedings That May Have a Direct Effect on Your Business

By ORSON D. MUNN, Litt.B., LL.B., Sc.D.
New York Bar
Editor, Scientific American

### A Bill Worth Watching

A WELL known Congressman, who has introduced many bills of far reaching effect, proposes to introduce during the coming session of Congress a bill which, if enacted into law, will revolutionize many phases of our present marketing system. The bill proposes to make it unlawful for a manufacturer or for an affiliate of a manufacturer to transport in interstate commerce any article or material produced by that manufacturer for sale or distribution at retail either by the manufacturer or by an affiliate of the manufacturer. Should this bill be passed by Congress, the various manufacturing and producing organizations which either sell directly or through the medium of a subsidiary or an affiliate corporation to the public will have to change their method of doing business or go out of business altogether. It is understood that the bill is aimed principally at the large chain store organizations. However, it would affect all types of industry.

### Be Discriminating When You Discriminate

IN its first attempts to enforce the Robinson-Patman Act, which has been variously referred to as the "anti-chain store" and the "anti-price discrimination" law, the Federal Trade Commission filed two complaints against prominent cheese manufacturers, alleging discrimination in prices between different purchasers, and another complaint against a manufacturer of floor covering material and a prominent mail order house, alleging that the manufacturer had given, and the mail order house had knowingly received, a discrimination in price in certain merchandise sold by the manufacturer to the mail order house.

These proceedings, if carried through to the courts, will test two of the most important sections of the Act, namely, Sections 2-A and 2-F. The first section relates to the giving of price discriminations by a seller and the second section relates to knowingly receiving discrimination in prices by a purchaser. These proceedings are brought under the portion of the Act which empowers the Federal Trade Commission to enforce it. In addition to giving the Federal Trade Commission power to enforce the Act, the Act also contains provisions making certain violations criminal offenses. At the time of writing no proceedings have been brought under the criminal provisions. Should the Federal Trade Commission find any of the complaints justified, it is empowered to issue an desist the practices complained of. The order of the Commission is then subject to review by the Federal Circuit Court of Appeals which can either enforce the order by granting an injunction or can modify or set the order aside.

### Codes—by Another Name

SINCE the NRA was declared unconstitutional by the Supreme Court, and especially during the last few months, there have been an increasing number of applications made to the Federal Trade Commission by various Trade Associations for permission to draw up fair trade practice rules to govern the particular industry which the Trade Association represents. The trade practice rules resemble somewhat the Code set up under the NRA with the exception that they do not include any labor provisions but deal solely with trade practices, as the name indicates. The rules are drawn up by representatives of the industry and are then submitted to the Federal Trade Commission for approval. The rules are usually divided into two groups, the first group dealing with practices which in the opinion of the Commission constitute violations of the law, and if any member of the industry violates any of the rules in the first group, the Commission will take steps to enforce it. The practices covered by the second group are not recognized by the Commission as violations of the law but merely as expressions of the industry on the question of ethical trade practices.

Some of the rules already approved by the Commission contain interesting provisions which might prove of importance in the stabilization of an industry, such as prohibitions against selling below the cost of production or selling below price lists which the seller has circulated. Most of the approved rules also contain provisions relating to price discrimination, interfering with the customers or employees of a competitor, and the imitation of labels and the like.

The Federal Trade Commission has been ready to approve such rules for many years but it has only been within the last few months that any appreciable number of applications have been made to the Commission. It appears as though this may be a development which will have a far reaching effect upon American industry.

### Watch That Disclosure

INVENTORS and manufacturers frequently inquire as to the liability of a manufacturer who makes use, without securing a patent, an invention which the inventor disclosed to the manufacturer. This question came before two separate United States Circuit Courts of Appeal within the last few years and both of them decided that where an inventor before applying for or receiving a patent discloses his invention in confidence to a manufacturer and the manufacturer makes use of the invention without the consent of the inventor, the inventor is entitled to compensation or damages for the use of his invention even prior to the date of his patent should a patent be granted. In both of the cases referred to above, the inventor ultimately secured a patent for his invention on one of which the patent was declared invalid, but the interesting feature of the two cases resides in the fact that the inventor was allowed damages for the period during which the invention was used prior to the granting of the patent, not on the theory of patent infringement, but on the theory of breach of confidence.

In one of the cases the Court held that it was not necessary that the invention be expressly submitted to the manufacturer in confidence but the mere fact that the manufacturer requested that the inventor disclose the invention to him was sufficient to constitute confidential relationship. Inventors seeking to protect themselves under the doctrines laid down in these two cases should take such precautions as to enable them to prove that their inventions were submitted under circumstances which would give rise to a confidential relationship. Manufacturers seeking to protect themselves from unjustified claims of breach of confidence should preserve careful records of all inventions conceived and developed in their organization and of all disclosures of inventions made by outside parties.

These cases serve to emphasize the importance of making and preserving complete records of all inventions in the manner outlined in the article entitled "A Weapon for Inventors," which appeared in the August 1936 number of Scientific American.

### Utility in a Game of Chance?

IN an interesting case of rather recent vintage, a Federal District Court has revealed the hereditary American moral position on the question of gambling by declaring that a patent on a mechanism of the class sometimes referred to as "slot machines" was invalid and lacking in utility. The owner of the patent contended that the patent related to a vending machine. The device in question consisted of a cabinet with glass walls having a number of articles of merchandise on display therein and in which was located a beam and scoop. By manipulation of the handle, the customer could adjust the position of the scoop and in this manner attempt to grasp some particular article therein. The Court took the position that the device could not be manipulated by the customer so as to deliver with certainty the merchandise he may desire and for that reason the patent was held to be lacking in utility and therefore invalid. The Court stated: "I do not believe the progress of science or the useful arts will be aided by this

# CURRENT BULLETIN BRIEFS

*(Bulletins listed as being obtainable through Scientific American can be supplied only by mail)*

SAFE MOTORING ON AMERICAN HIGHWAYS is a typescript of a broadcast interview between William O'Neil, President of General Tire and Rubber Company, and John B. Kennedy, noted news commentator. It gives Mr. O'Neil's opinions as to highway safety. *Write for Bulletin 137A to Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

HOW TO USE THE NATIONAL BETTER BUSINESS BUREAU, while definitely an appeal for financial support of this Bureau, tells in concise question-and-answer form of the activities of the Bureau and how it can be of assistance to business and industry. *National Better Business Bureau, Inc., Chrysler Building, New York City.—Gratis.*

THE REPUBLIC OF ECUADOR AND HER PRINCIPAL AGRICULTURAL PRODUCTS is a 20-page pamphlet, illustrated with photographs, telling some of the pertinent facts regarding this relatively little known country. *Dr. Francisco Banda C., Director General of Commerce, Department of Foreign Affairs, Quito, Ecuador, S. A.—Gratis.*

INDUSTRIAL USES OF MICARTA describes and illustrates the many uses for a plastic material which is available in a number of grades and shapes. Many specific applications are shown in photographs; mechanical and electrical properties as well as standard forms available are listed. *Write for Bulletin 137B to Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

130 PHOTO-FAULTS, by Wolf H. Doring, deals with the many mistakes that the photographer can make from the instant of exposure up to the production of the final print in either contact or enlarged form. *American Photographic Publishing Co., 428 Newbury Street, Boston, Massachusetts.—40 cents.*

DC VOLTAGE DISTRIBUTION IN RADIO RECEIVERS is prepared specifically for the radio service man who desires to keep up to the minute with his work. It provides a background of knowledge that cannot be found elsewhere in such compact form. *John F. Rider, Publisher, 1440 Broadway, New York City.—60 cents.*

GRINDING AND FINISHING WITH PORTABLE EQUIPMENT tells of the growing field of use for portable grinders in many diversified industries. It also lists the various types of abrasive wheels and points that are available for accomplishing specific work. *Write for Bulletin 137C to Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

CALIFORNIA, Volume I, No. 1 of the Magazine of Pacific Business, is prepared with a fine format including numerous illustrations in color as well as black and white. It deals specifically with industries in California. *Business, Ferry Building, San Francisco, California.—25c a copy, $2.00 a year by subscription.*

AIR CONDITIONING—REFRIGERATION—SPACE HEATING illustrates and describes complete equipment for industry, business, and the home. The wide variety of available units and central plants is indicated by the tables giving capacities and ratings. *Write for Bulletin 137D to Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

CELESTIAL NAVIGATION, by Albert W. Ames, offers to those who may wish to know, without a serious study of the subject, the relation between navigation and the sun, moon, and stars. It is complete enough for practical use and shows how astronomy has been simplified in its practical application to the latest method of navigation. *The Candler Company, 1810 34th Avenue, Seattle, Washington.—50 cents.*

THE MAKING AND SHAPING OF ALLOY CONSTRUCTURAL STEELS, by E. C. Smith, gives first a definition of an alloy steel and leads up to modern methods with a brief summary of the early days in steel manufacturing. Most of the booklet is devoted to modern practice. Well illustrated with a series of photographs. *Write for Bulletin 137E to Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

LORD KELVIN—MASTER OF HEAT AND COLD gives a brief summary of the life and work of William Thomson, born June 26th, 1824, and raised to the peerage as Lord Kelvin of Largs in 1892. This is a valuable addition to the human-interest side of physics. *The Temperature Research Foundation of Kelvinator Corporation, 420 Lexington Avenue, New York City.—Gratis.*

THE MAHOGANY BOOK describes and illustrates in 80 pages the various uses for mahogany in the decorative arts and also shows definitely the distinctive characteristics which make mahogany such a beautiful and enduring wood. The covers are printed in simulated mahogany. *Mahogany Association, Inc., 75 E. Wacker Drive, Chicago, Illinois.—Gratis.*

TOURISM IN THE NETHERLANDS INDIES is a beautifully prepared booklet describing the scenic wonders of Malang, one of the high-altitude residential cities of Java. A map of Malang and environs is included. *The Travellers Official Information Bureau of The Netherlands Indies, Rijswijk 15—Batavia-C., Java.—Gratis.*

BLONDIN'S AIRCRAFT CHART is a compilation of 94 pictures, on one large sheet, arranged in numerical order and illustrating the evolution of every type of aircraft. Each one is briefly yet comprehensively described. *Blondin Chart Co., P. O. Box 34, Los*

# Books SELECTED BY THE EDITORS

## THE STORY OF HUMAN ERROR

*By Joseph Jastrow and 15 other scientists*

READERS with a special interest in odd and abnormal things will enjoy this book. For each branch of science a specialist relates the errors into which past scientists have fallen. For example: error in astronomy (Stetson), in geology (Mather), in geography (Leighly), in physics (Swann) . . . and so on for chemistry, zoology, physiology, neurophysiology, anthropology, psychology, sociology, medicine, psychiatry. Science in the past has run up some odd and often amusing blind alleys. No doubt some of its choicest present-day tenets will be recited in another book on error, about A. D. 2036.—$3.70 postpaid.—*A. G. I.*

## RADIO FIELD SERVICE DATA

*By Alfred A. Ghirardi, E.E.*

SUPPLEMENTING the 1300-page text book, "Modern Radio Servicing," this second edition brings the radio service man strictly up to date for work in his field. The loose leaf form has been adopted in order to make it possible to keep the book up to the minute at all times by regular periodic supplement sheet service. This latest edition covers modern radio receivers from the standpoint of trouble shooting, gives information on automobile radio receivers and their troubles, and lists the characteristics of all modern vacuum tubes. A complete series of tables gives valuable data on wire sizes, common metals and alloys, transformer design, and so on.—$2.70 postpaid.—*A. P. P.*

## SKYWAYS TO A JUNGLE LABORATORY

*By Grace Crile*

THE wife of a famous physician gives a diary account, very readable, of an expedition to Africa in an airplane, in order to study specimens of wild animals.—$2.90 postpaid.—*A. G. I.*

## COLLECTING STAMPS FOR FUN AND PROFIT

*By A. Frederick Collins*

PROGRESSIVE educators have come to the realization that the philatelic hobby is excellent as an outlet for the natural tendency of children to collect things. It imparts in painless doses a broad knowledge of art, geography, exploration, transportation, natural history, architecture, and so on—all of ly on stamps of all nations. Mr. Collins' book is essentially for the embryo collector, but it should prove of equal interest to those who know how to wield a perforation gage. It outlines how a stamp collection should be started and how to nurse its growth. Historical data that every philatelist should know are given, as well as a general idea of the printing of stamps. The latter portion of the book deals with the finer points of philately with which this reviewer would not be surprised if some of his brother philatelists were as unfamiliar as he.—$2.15 postpaid.—*G. C. B. R.*

## MODERN ALCHEMY

*By Dorothy M. Fisk*

THIS is a lively and graphic account of science's latest significant game, the transmutation of elements, by a lady who is as entertaining as she is well-versed in physics. Its best chapters deal with the history of alchemy up to its present ultra-modern form, including, as they must, the developments in allied fields of physics and chemistry. The treatment is non-mathematical, the result extremely readable, and, with a few minor exceptions, accurate.—$1.90 postpaid.—*J. H.*

## PROCEDURE HANDBOOK OF ARC WELDING DESIGN AND PRACTICE

*Fourth Edition*

ANYONE who knows welding and welding operations should be familiar with this volume now in its fourth edition, revised and greatly enlarged. It brings up to date every detail of welding operations from the design of structures through to the advanced production, including methods, technique, procedures, and metallurgy of the many metals and alloys which may be welded today.—$1.50 postpaid in U.S.A., $2.00 postpaid elsewhere.—*F. D. M.*

## SO YOU'RE GOING TO A PSYCHIATRIST

*By Elizabeth I. Adamson, M.D.*

PSYCHIATRY, often confused with psychology, is a cat of another color —in fact, almost a different animal. Psychologists are generally students of the human mind. Psychiatrists seek to take the kinks out of minds. Psychologists, psychiatrists are physicians usually connected with hospitals. This book is on the psychiatric side and has to do with the kinks in the more or less abnormal mind and how they are straightened out. It is written in simple, straightforward language. The reader will learn a great deal about the motives and mechanisms of the mind—including his own if only he is frank with himself.—$2.65 postpaid.—*A. G. I.*

## MONSTERS & MADONNAS

*By William Mortensen*

IF the amateur photographer can stand an intensely satirical commentary on his hobby—particularly if he be one who thinks that possession of a good camera necessarily makes him a good photographer—he will thoroughly enjoy the preface to this book which treats particularly of the methods of the artistic photographer. If not, he should skip the introduction and plunge directly into the outstanding full-page illustrations and accompanying text which tells definitely how certain desirable results were achieved. Essentially a book of methods, this paper-covered volume with spiral binding presents a number of beautiful photographs ranging from portraits through nudes to the grotesque. No photographer who has the least bit of artistic talent can fail to profit by the thoughts presented here.—$4.15 postpaid.—*A. P. P.*

## KENT'S MECHANICAL ENGINEERS' HANDBOOK—POWER

*By Robert Thurston Kent, M.E., Editor-in-Chief, with the Collaboration of a Staff of Specialists*

THERE is perhaps no engineer in the country who is not familiar with Kent's. A traditional authority, this volume has long since outgrown the pocketbook size and in this newer volume reaches the dimensions 8½ by 5¾ by 1¾ inches. As to its content, an engineer need only know that it has been brought up to date in every respect. It is 1226 pages long and should be on every engineer's library shelf.—$5.20 postpaid.—*F. D. M.*

## WORLD POPULATION

*By A. M. Carr-Saunders*

AN elementary but quite detailed study of population, with a discussion of the causes and consequences of the im-

has taken place in the past 300 years and a statement of the problems which arise from the world population position as it is now. The emphasis is on the former—the statement of conditions—rather than on detailed or lengthy debate on what to do about it; in other words, this is not an argumentative book but, in the main, a book of facts, and its reader would carry away a good solid understanding of the subject of population as a take-off for further study. Its author is English.—$4.70, postpaid.—*A. G. I.*

### TWO HUNDRED METERS AND DOWN
*The Story of Amateur Radio*

*By Clinton B. De Soto*

IN probably no other scientific development in history have laymen played as great a part as in the growth of radio telegraphy. From the very earliest days of wireless communication these laymen—"amateurs" in the vernacular of the art—have contributed largely of their time and skill in searching for the solutions to the multitude of problems that constantly beset their paths. The history of amateur radio is inspiring, due largely to the fact that they have been constantly on a frontier, exploring sections of the radio spectrum which have been cast aside as worthless. As a result of these explorations has come about the development of short wave radio as we know it today. In the present book the author has traced this work from its beginning to the present, and has concluded with a glimpse into the future. Every amateur will want this book. Anyone interested in radio must read it to round out his knowledge of the subject. 184 pages, limp composition cover.—$1.10 postpaid.—*A. P. P.*

### HANDBOOK FOR THE CURIOUS

*By Paul Griswold Howes, Curator Bruce Museum, Greenwich, Conn.*

VARIOUS animals from sponges and jellyfish, to worms, starfish, crustaceans, spiders, molluscs, fish, amphibians, and reptiles, such as anyone is likely to see while on a walk, are described and identified by photographs in this book. The treatment is popular and chatty.—$3.90 postpaid.—*A. G. I.*

### DIESEL APPLICATION PLAN BOOK

*Edited by John W. Anderson*

DONE in a sort of loose-leaf form with the new celluloid ring binding, this volume contains numerous plans for the installation of Diesels in all types of plants and vehicles. These complete plans are reproduced as blueprints and the diagrams are very clear because of the size of this book—9 by 12 inches. The Diesel engineer, the plant operator, of motive power for any purpose will get many valuable suggestions from this very readable volume. It contains 239 pages of text and a large advertising section of Diesel engines and auxiliary equipment.—$5.20 postpaid.—*F. D. M.*

### NEW WAYS IN PHOTOGRAPHY

*By Jacob Deschin*

HOW to obtain the best possible results with his camera, particularly when he does all of his own finishing, is the aim of the serious minded amateur photographer. The Editor of "Camera Angles" in Scientific American has prepared this latest addition to the literature of photography with just this fact in mind. The book is eminently practical from every point of view. It contains nothing of theory and nothing that the advanced amateur will not find valuable in one way or another in the course of his work. It covers the whole range of amateur photography—sometimes even bordering on the ways of the professional. It discusses varied phases of trick photography, commercial photography, photomurals and transparencies, retouching, infra-red photography—in fact, it runs the whole gamut of the art, leaving nothing untouched. Ideas for photography will be found in plenty here; the average amateur will revel in the details given and particularly in the excellent accompanying photographs.—$2.90 postpaid.—*A. P. P.*

### LIVE LONG AND BE HAPPY

*By Llewellys F. Barker, Prof. Emer. Medicine, Johns Hopkins Univ.*

"HOW to Prolong Your Life and Enjoy It" is the sub-title of this book which discusses the desire to live long, heredity and longevity, environment and longevity, personal habits and longevity, and the prolongation of life through the prevention and adequate treatment of all the main diseases that afflict us poor mortals. Most of the book is then devoted to a description of these diseases, which would fill in the reader's background of information about divers diseases (if it did not make him think he had them all), with data on the methods usually employed in treating them—not, however, specific data on home treatment, for this is no old-fashioned "doctor book."—$2.15 postpaid.—*A. G. I.*

### THE HOUSEHOLDER'S COMPLETE HANDBOOK

*By Hawthorne Daniel*

HOW to repair anything from a leaky faucet to a leaking roof or from a burnt-out fuse to a stubborn heating system is told in this comprehensive book of 420 pages, which includes an ex- has a few simple household tools, he will find himself ready to tackle almost any job around the house if only this book is kept figuratively in one hand. Illustrated with line drawings that clarify the text—$2.70 postpaid.—*A. P. P.*

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### PROJECTION CONTROL

*By William Mortensen*

THERE is usually a vast difference between the ordinary contact print produced without any concern for improving quality and an enlargement from the same negative that has been handled by one skilled in the art of projection. The author of the present book strives to make clear those steps and tricks in projection which mean the difference between an ordinary enlargement and a strikingly beautiful artistic composition. He covers such phases as framing, local printing, distortion, montage, and texture. The book is beautifully illustrated with photographs that definitely annotate the text.—$1.90 postpaid.—*A. P. P.*

### ELECTRICITY

*By W. L. Bragg, Professor of Physics, Victoria University of Manchester*

TRANSCRIPTS of six popular lectures given to a juvenile audience at the Royal Institution in London form the substance of this book, which covers the elementary ground of applied electricity. What is Electricity?; How Electricity Travels; Motors and Dynamos; Our Electrical Supply; Telegraphs and Telephones; Oscillating Electrical Circuits—these are the separate titles of the lectures, which are lucid and very readable, and are not noticeably juvenile, though they are elementary. The author is a Nobel Prize winner and a noted physicist.—$4.15 postpaid.—*A. G. I.*

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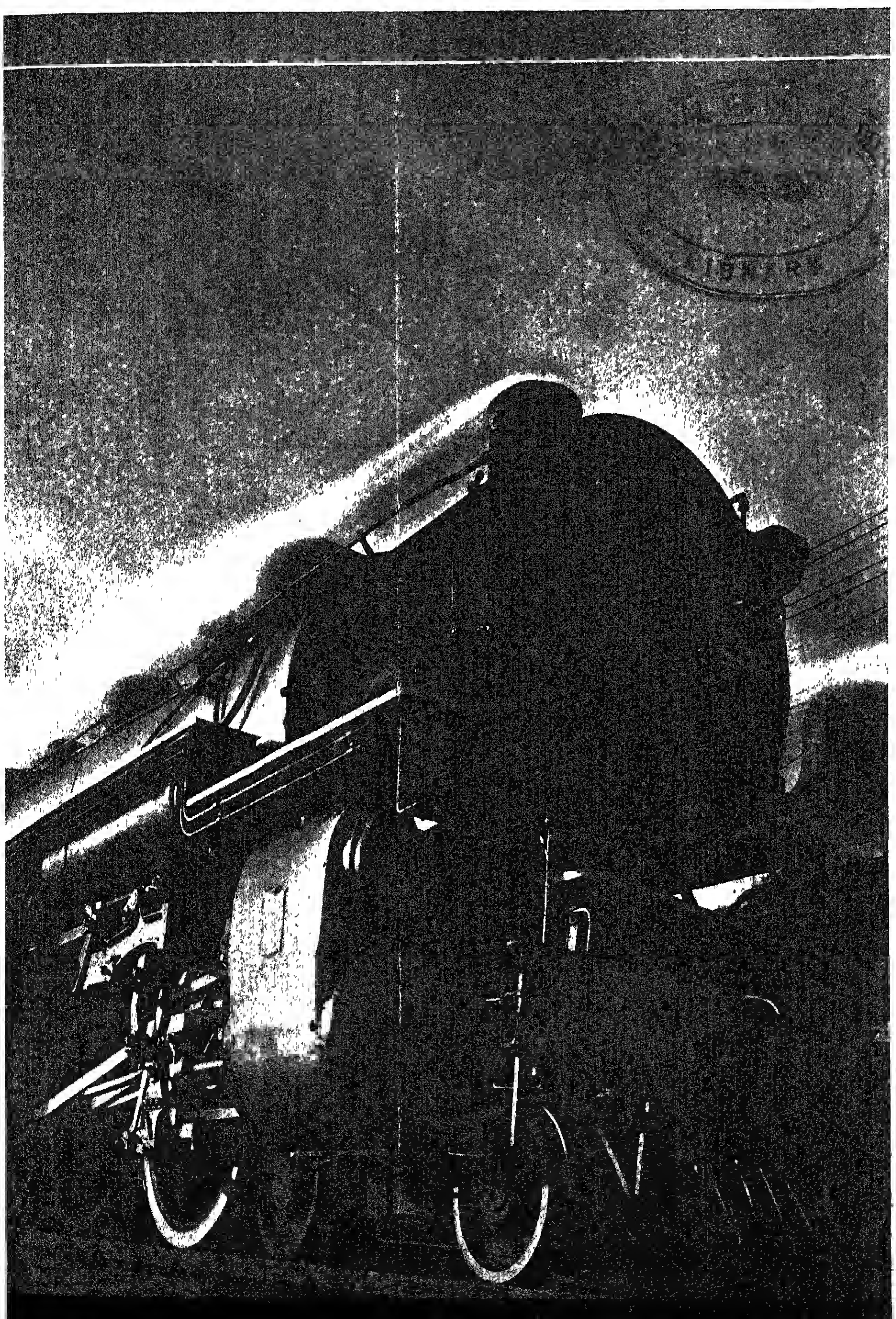

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NINETY-THIRD YEAR • ORSON D. MUNN, Editor

## CONTENTS · FEBRUARY · 1937



PERHAPS more romance is woven into the fabric of railroading than can be found in any other phase of transportation. Thus it seems peculiarly appropriate that this issue, containing as it does a series of articles on vital phases of transportation, should have for its cover illustration the dynamic photograph of a steam locomotive doing its prosaic every-day job of hauling traffic, yet holding a thrilling, romantic appeal.

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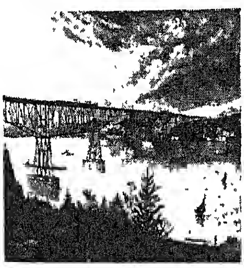
# 50 Years Ago in . . .

# Scientific American

*(Condensed From Issues of February, 1887)*

POUGHKEEPSIE BRIDGE—"A glance at any map of the Eastern and Middle States will show the need of a bridge over the Hudson River at a point midway between New York and Albany. All traffic between the New England States and the West and South over either of the lines having a terminus at Jersey City is subjected to more or less delay, caused by crossing the Hudson at that point. The Poughkeepsie bridge, together with about twelve miles of road to be built between Poughkeepsie and Gardiner, will obviate this difficulty by making an almost direct route from Boston and Springfield to Scranton and the anthracite coal fields and Harrisburg."



INVENTORS—"By all means let us give every encouragement and aid possible to inventive genius. Instead of contracting, let us enlarge in every manner possible the scope and usefulness of the Patent Office. Instead of sneering at the 'crank' inventors of patent devices, let us honor them as the greatest benefactors of their race."

DIAMONDS—"Among the many theories existing as to the formation of the diamond, that of Professor Simmler, of Switzerland, is certainly not the least probable. . . . If carbon be soluble in liquid carbonic acid, it would then only be necessary to subject the solvent to slow evaporation; the carbon would thereby be deposited, and, by taking proper care, assume crystalline forms."

STUDY—"The acquisition of learning without study is like the acquisition of wealth without labor. It is as necessary for the mechanic to study out his problem when it comes to him to be studied as it is for him to finish his task by his handicraft."

SUBMARINE—"Submarine boats are a much older invention than is generally conceived; but they are now coming prominently forward . . . because modern devices have rendered it possible to construct vessels which can be propelled safely beneath the surface of the water. Who first suggested the idea is not known; but it seems well authenticated that in the reign of James I, a Dutchman named Drebbel designed a boat which was actually propelled by twelve oars under the surface of the Thames, the air being re-vivified by some liquor, the composition of which Drebbel kept a secret."

SALT—"One of the most remarkable salt formations in the world is located on the isle of Petit Anse, Southwestern Louisiana. . . . The deposit is pure crystal salt. So far as it has been traced, there are 150 acres of unknown depth, explored 140 feet down."

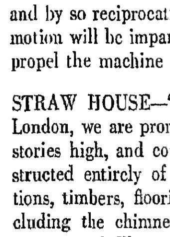
YACHT—"The Harlan & Hollingsworth Company has lately finished for Mr. William K. Vanderbilt the steel yacht *Alva,* the finest pleasure ship afloat, at a cost, it is said, of about one million dollars."

TRAIN HEATING—"The frequency of accidents and loss of life arising from car-heating stoves is awakening public attention everywhere, and even railroad officials are beginning to realize the necessity for some safer means of warming their cars than are now in use. The heating of cars by steam from the locomotive would seem to be the most effective and the least objectionable method; but railroad engineers are almost unanimous in their condemnation of the use of steam for the purpose."

FUEL—"It appears, after an experiment of several months, that ferry boats plying between San Francisco and Oakland, which have been fitted up for burning petroleum, have now gone back to coal. The economy, as we understand, so far as the consumption of fuel is concerned, is said to be decidedly in favor of petroleum; but the trouble in its use came from the intense heat produced, by which, or by the peculiar nature of the combustion, the iron of both the furnaces and boilers began to indicate rapid deterioration."

COCAINE—"A number of cases of confirmed cocaine habit have recently been reported. While some of them lack confirmation, it is certain that several physical and mental wrecks have been caused by the excessive use of this alkaloid. . . . If the cases continue to multiply, there may be room for questioning the utility to man of the discovery of this anesthetic. It is doubtful if all the services in local anesthesia rendered by it can compensate for the ill it has already done."

SWING BICYCLE—"The bicycle shown in the accompanying engraving is the invention of Mr. Nathaniel Brown, of Emporia, Kans. The wheels are secured to the outer ends of two hollow axles or shafts, which are mounted upon a central shaft, and are formed with ratchet wheels and friction disks. . . . The pulling of the levers downward starts the main wheels forward, and at the same time swings the seat forward, thus moving the pawls carried by the arms supporting the seat backward. . . . As the levers are moved forward, the swing of the seat toward its normal position will act to advance the bicycle, and by so reciprocating the levers it will be seen that a pendulum motion will be imparted to the seat, which will, when once started, propel the machine for some time."



STRAW HOUSE—"At the forthcoming American Exhibition in London, we are promised . . . a house of straw . . . two and a half stories high, and covering a space of 42 feet by 50 feet. It is constructed entirely of materials manufactured from straw—foundations, timbers, flooring, sheathing, roofing, everything in fact, including the chimneys—the material being fire proof as well as water proof. The inside finish is to be in imitation rosewood, mahogany, walnut, maple, ash, ebony, and other fine woods, the straw lumber taking perfectly the surface and color of any desired wood."

DAMS—"Among the most important dams built in California are: The Bowman dam, height 100 feet, length 425 feet; three dams owned by the Milton Mining and Water Company, forming the English reservoir, the largest of these having a height of 131 feet; the Fordyce, of the South Yuba Canal Company, 567 feet long and 75 feet high, catchment basin, 40 square miles; the Eureka Lake dam of the Eureka Lake and Yuba Canal Company,

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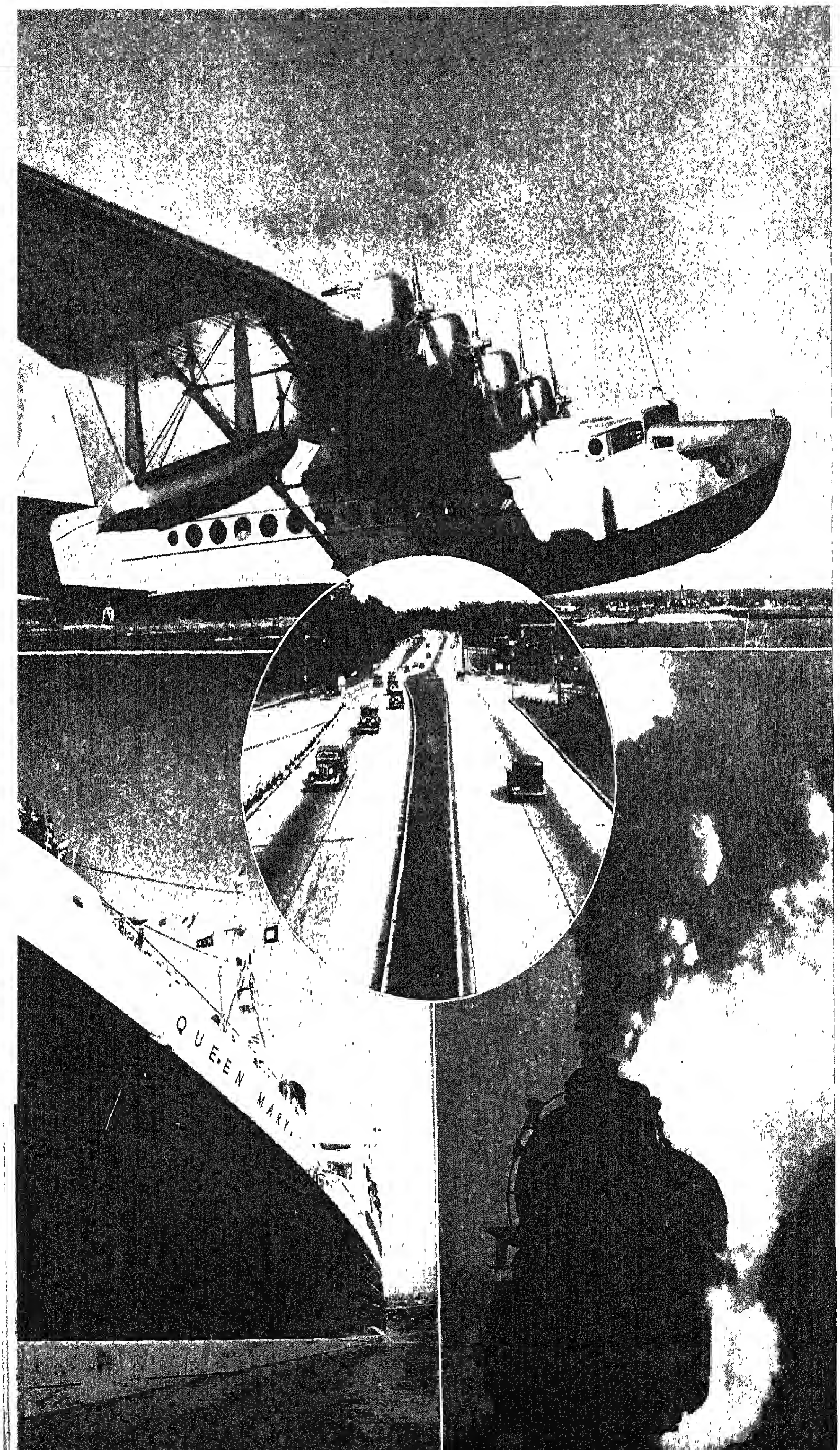
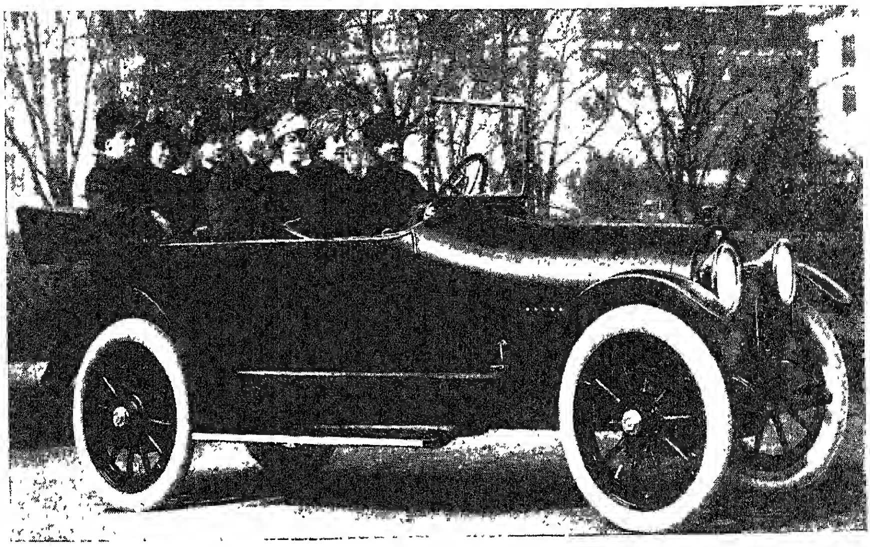
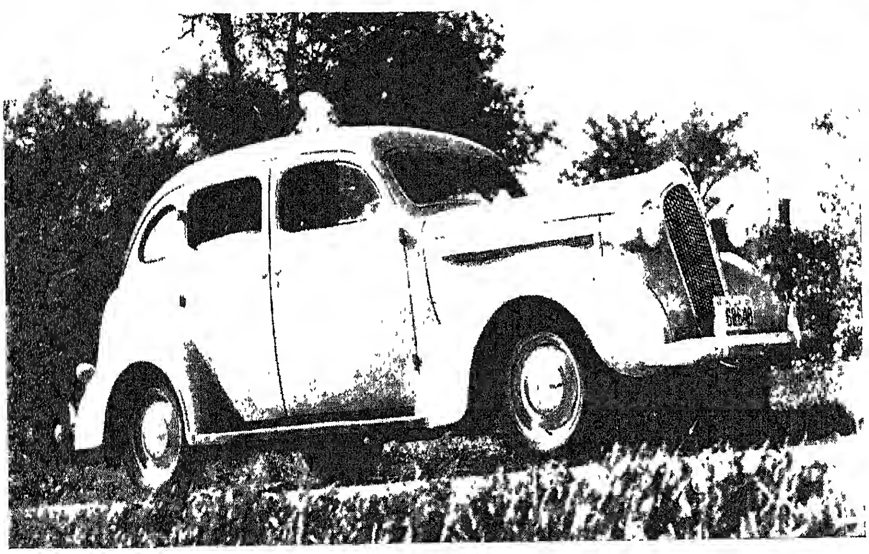
- Consider the Dinosaur, by Roy Chapman Andrews
- The Cruiser in Naval Tactics, by Walton L. Robinson
- The Problem of the Holy Shroud, by Paul Vignon, Sc. D.
- More Power for the Locomotive, by Prof. Edward C. Schmidt
- San Gabriel Dam, A Mighty Engineering Project, by Andrew R. Boone


QUEEN MARY



In 1915 you would have had to pay 1550 dollars for this touring car that offered plenty of fresh air and sunshine, a not too smooth running motor, high-pressure tires, one-man (?) top, noisy gears, and other modern—at the time—improvements, including electric lights, but . . .



In 1937, you can buy this four-door touring sedan for 680 dollars, f.o.b., with low-pressure tires, safety glass, silent gears and hypoid rear end, quiet motor, ventilated interior, and all the other advances in automobile construction that have been made possible by improvements in materials and production

# THE RÔLE OF THE AUTOMOBILE

## Individual Transportation . . . Has Transformed The National Scene . . . Steady Decline In Price . . . Safety A Paramount Issue In Design

By WALTER P. CHRYSLER
Chairman of the Board, Chrysler Corporation

IN the history of the various forms of transportation, the automobile has a unique place. Before its advent the railroad had dramatically reduced the time necessary for transporting both goods and passengers to a fraction of that required in the days of the Conestoga wagon or the stage-coach; since its development the airplane has cut this time element to a still smaller fraction. The rôle of the automobile has been to provide an *individual* means of transportation, available for the great mass of people, which has succeeded in annihilating distance to an extent that we can realize only by comparing travel today with travel only a short forty years ago.

If automobile manufacturers had envisioned their industry only as producing another means of transportation, the automobile would not today hold anything like the place in American life which it now commands. It would certainly be important, but it would not be necessary. As an individual means of transportation within the reach of something like two thirds of all American families—and rapidly being extended to this final third—it has transformed the national scene. The American people have obtained a mobility which is one of the outstanding phenomena of the present age. In conjunction with the roads, construction of which it has fostered, the automobile has brought the country to the city and the city to the country; it has broken down all barriers of distance; it has offered millions a recreational activity whose popularity is at-

tific American DECEMBER 10, 1910.

Fore-Door Demi-Tonneau [Tonneau Detachable]

# The $1500 Abbott-Detroit In Many Respects Equals $4000 Cars

THE Abbott Detroit is the one fully standardized motor car sold at $1500. It equals in many features and in its record many cars sold up to $4000.

Its painting and trimming specifications are parallel to those of any $4000 car on the market.

The Abbott-Detroit has Chrome Nickel Steel Construction in the transmission and rear axle with imported F. & S. Annular Bearings and Timken Roller Bearings.

The Abbott-Detroit has a complete electric light equipment of two electric head-lights and combination electric and oil side and rear lamps and Bosch High Tension or Splitdorf dual ignition system.

## We Cannot Mention Here All The Features You Should Know About

If we had the space to point out to you how every part of the Abbott-Detroit has been brought to such a stage of perfection that we find it impossible to make any improvements, we could make you an Abbott-Detroit enthusiast.

We simply ask you, however, to consider this conclusive evidence of thoroughbred quality that the Abbott-Detroit has never failed to place in a race or endurance run and has defeated some of the best cars built regardless of price.

## Let Us Send You All The Vital Information You Need

The Catalog of the Abbott-Detroit will open your eyes to the fact that when you purchase the Abbott-Detroit you will get more for your money than you ever expected to get in any motor car.

We can show you a purchase that will be one of the real satisfactions, the genuine values of your entire experience.

## Just Sign Your Name And Address To The Coupon

Then tear it out and mail it. We'll send you the Abbott-Detroit Illustrated Catalog by return mail and prove to you that this is the car you want and must have just as soon as you realize what a wonderful car the Abbott-Detroit car is, especially at $1500.

And to Dealers wanting territory not already closed we'll be glad to make our regular Agency Proposition. Our production is limited and large contracts are closed. Prompt action is important. PRICES: [illegible]

## Abbott Motor Company

121 Waterloo Street Detroit, Michigan

*"The Place for You to Sign"*

*Name* ____________

*Address* ____________

**Above:** **Reproduction of an advertisement that appeared 27 years ago in Scientific American, extolling the virtues of a car of the times. Compare the details with the photograph, *below*, of a 1937 motor car that represents the latest in automotive engineering and body design**

tested by traffic on our highways every day of the year.

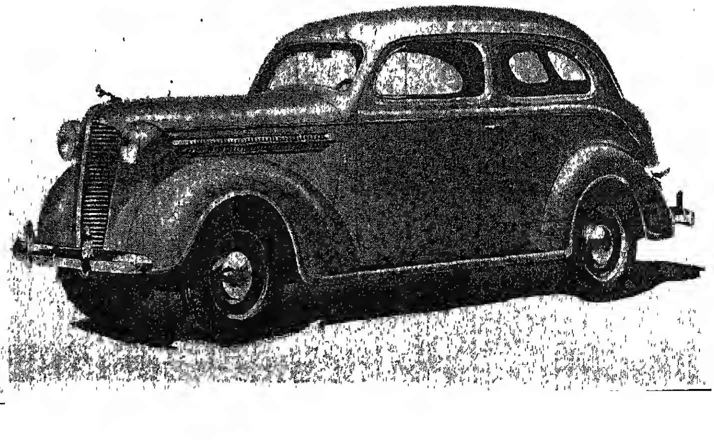
This has been brought about by the relentless pursuit on the part of automobile manufacturers of two major objectives: consistent improvement in the mechanical operation of the automobile, and a steady reduction in its price to purchasers. The inventive genius, the patient industry, the forward-looking spirit which were the hall-mark of the inventors of the automobile, have characterized the industry since its inception. It has never been content to rest on its laurels; it has never been content to accept last year's models as the best it could produce.

As everybody knows, the popularity of the automobile has increased by leaps and bounds. What has made possible this remarkable growth in the number of automobiles is an even more absorbing chapter in the history of transportation. It would not have been possible except for the development of mass production and the steady decline in prices of motor cars as patient research has developed more economical methods of manufacture. In achieving these twin ends, the industry has also provided a means of livelihood, on a steadily ascending scale, for an ever larger number of persons—it today does so, directly and indirectly, for some 6,000,000 wage earners, one out of every seven gainfully employed.

OFFICIAL figures for the industry in the United States and Canada show that the average value of the 4000-odd passenger automobiles produced in 1900 was over 1000 dollars and during the next decade this average figure increased rather than declined. There was a vast improvement in the construction of the automobile, but this improvement meant higher costs. The average value of the automobiles manufactured in 1906, for example, was almost 2000 dollars apiece. By 1912, however, this trend was definitely reversed. The average value fell to less than 1000 dollars and in the years just prior to our entry into the World War the average value of an automobile was not much more than 600 dollars.

In succeeding years economic conditions caused an interruption to this downward trend but it was soon resumed and in 1929, when production reached its peak with an output in that one year of 4,795,000 passenger cars, the average value of an automobile was again about 600 dollars. But if the industry was then forced to curtail production, the depression brought no halt in its intensive efforts to build at the same time better and more economical automobiles. The average value of the greatly reduced number of cars manufactured in 1932 was approximately 550 dollars and in 1935, with production again on the upward grade, this figure had still further declined to a little more than 500 dollars.

It need hardly be stated that this reduction in the price at which the average citizen could purchase an automobile



was not brought about at the expense of quality of the product. In ease of operation, in efficiency, in durability, in appearance, in economy, and in safety, the automobile of today represents as marked an improvement over that of a decade ago as did the automobile of 1927 over that of 1917, or the 1917 model over that of 1907.

More money has been expended during 1936 to meet the steadily rising demand for automobiles than in many years. New plants have been built and equipped with the most modern labor-saving machinery, obsolete machinery has been replaced, and manufacturing processes have been improved and speeded up all along the line.

BUT possibly the most important development in the manufacture of today's motor cars has been the very definite increase in their safety. The automobile industry fully recognizes its responsibilities to the public, and no expense or effort is being spared to make the modern car as safe as is humanly possible.

Figures compiled by the National Safety Council, Inc., show that motor transportation is today the safest of all means of transportation on the basis of occupant mileage. It is being made safer every year. With the support of the motoring public, still further progress should be assured for the future.

The industry is meeting the problem directly with its manufacture of safer cars. The safety steel body, hydraulic brakes, safety interiors, safer steering, easier control, and better vision are steps along this path. The modern car is practically unbreakable, and the danger of faulty parts has been almost entirely done away with. But manufacturers cannot control the human element in automobile operation. If complete safety is to be assured, these remarkably safe cars must be driven


At the turn of the century. Ads from Scientific American. One at lower left (1898) was the very first automobile ad to appear in any national publication

safely. To this end, the industry is co-operating in a nation-wide drive to promote reasonable safety policies.

In the development of the modern car, the industry has not by any means come to the end of the road. The 1937 models will not long stand as the last word in automobile construction. Research departments are working on further improvements as steadily as at any time in the past.

The record of the past few years, which have seen such a marked increase in the demand for automobiles, provides striking evidence of the public's reaction to this program for building better and safer cars. Automobile manufacture should continue to stand in the forefront of American industrial progress as this country once again renews its onward march in raising our national

# OUR POINT OF VIEW

## Transportation and Recovery

TO borrow a cliché of the tripper and add substance to it: "The world is such a small place, after all—after all the shrinkage to which it has been subjected by scientific achievements in communications and transportation." To some, this, too, may sound like an old story but it is not except perhaps in the phrasing. Communications, it is true, have long since been stabilized so far as basic details are concerned; their most recent conquests have been primarily a matter of mileage and refinements. Not so transportation. Here, a great complexity of elements have had the attention of as complex a group of specialists. Transportation, in the past ten years, has made mighty strides; and its advances in the very recent past certainly is a new story. Has that story anything to do with our economic recovery? Perhaps.

In the past, the United States usually found and conquered a new frontier to lift itself from the depths of panic and depression. There was a belief that expansion of credit and re-employment of idle men depended upon new inventions opening up huge new fields of endeavor or the tapping of hitherto idle resources. In earlier days, it was a trek westward and a great forward surge of inventions that brought new wealth, employment, and a higher standard of living. More recently, a new industry, radio, is given the principal credit for our recovery from the economic distress of 1921. In the recovery of 1936, however, it seems to us that an old frontier, transportation, an old set of inventions have led the way.

The articles in this issue give but a brief résumé of the amazing accomplishments chalked up to the credit of various forms of transportation. To discover the part they have played in recovery of national well-being, one must, however, read between the lines. Whence came the initial impulse, is even less definite. Both the railroads and the automobile industry played star roles, with, perhaps, the latter having the edge.

The initiative of the automobile industry in laying out an aggressive, forward-looking program, in offering a finer product, expanding plants, employing more men, and in holding their national shows in the fall of 1935, started an unprecedented surge of buying which had repercussions throughout the industry and all those allied with it. Prosperity is contagious. Bonuses, higher dividends, re-employment have resulted. Cars and trucks made in 1936 were 4,565,000 (estimated) as against 4,119,811 for 1935. Yet, as was noted in our January issue, the cars on the road today have an average age of five years, thus contributing a tremendous replacement market that has yet to be satisfied. Who will dare predict the number of cars that will be made in 1937 to take up this back-log!

What of the railroads? Long criticized for a complacent superiority complex that admitted no possibility of real competition on the American scene, these giants have bestirred themselves. The criticisms were never quite merited for the railroads have always moved forward quietly, unostentatiously. The time came, however, when competition and the depression so reduced income that a spectacular fight became necessary. The start of the fight probably dates back to the first air conditioning of trains by that grand old road, the Baltimore & Ohio, something the public could understand—and enjoy. Other roads rapidly followed suit. Then suddenly, like a meteor streaking across the land, came the first streamlined train. The public was enthralled. A score of similar trains followed rapidly. The public once more became railroad-conscious; and with the increased revenues the railroads are buying new locomotives, finer cars, rails, equipment. The final touch—a master stroke, say the experts—was the reduction of fares! For months now, all comment regarding railroads invariably has included an expression of amazement at the crowding of trains, the recapture of passenger and freight traffic by the roads. They are making money for the first time in years, and so are their employees and industries doing business with them.

We have left little space to discuss other phases of transportation. It is not that their part in recovery is doubted but rather because, with the above examples before you, you can, as we hinted, more readily read between the lines of the discussions in this issue. The progress and future possibilities of water-borne transportation is succinctly told by Kermit Roosevelt; aviation's very real progress by Reginald M. Cleveland; the mushroom-like growth of the trailer industry by Philip H. Smith. Buses fill an important niche in the question as I. B. Babcock so ably explains; and neither automobiles nor buses would take so important a part in American life were it not for our splendid highways of which Alfred H. Swayne writes.

"Seven," to the ancients, was a magic number, as it is to some wood-knockers today. Seven important phases of transportation are discussed in this issue. Let us not deceive ourselves, however, for it is no magic that has placed these seven in the vanguard of national recovery. Rather is it a combination of virtues inherent in American industry that discovered and is conquering this new-old frontier. Initiative, enterprise, and courage, operating under the oldest, most successful economic system extant today, are lifting the country out of the depression "by its own bootstraps."

## Dr. Diesel

JUST 40 years ago an inventor was elated when his invention blew up; to him the explosion proved the soundness of the principle he had so carefully developed. Shortly thereafter his invention was perfected, and since has slowly found an ever-widening use as it was as slowly refined and improved.

The inventor was Dr. Rudolf Diesel, a university-trained engineer; and his invention, the compression-ignition, or Diesel, engine. Today it powers vehicles of the land, sea, and air, and supplies the driving force in practically every field where power is used. Its recent rapidly growing use is most remarkable, as is indicated by production records: Capacity of all Diesel engines built in the United States in 1934 totalled 750,000 horsepower; in 1935, 1,200,000; in 1936, 2,000,000!

Transportation is accountable for much of this more recent growth in Diesel use. In this field, Dr. Diesel's invention has a significant future; and our story of transportation would not be complete without tribute paid to the inventor and all those scientists and engineers who, following him, have tempered and strengthened the link in the chain of progress which he forged.

Diesels have a future so bright that no one can predict the ultimate extent of their use. Rapid headway is being made by them in many directions, and particularly in the field where spectacular effects are being obtained. How far such headway will carry them, only time will tell. But if Dr. Diesel could return to view the present results of the creation of his brain, on this its 40th anniversary, he could not help but feel a justifiable pride in his achievement. He builded better than he knew!

# Down to the Sea

## Modern Liners . . . Efficient . . . Comfortable . . . Safe . . . Speedy . . . Great Recent Improvements . . . Scientific Design And Equipment . . . Air Competition?

By KERMIT ROOSEVELT
Vice President, United States Lines; President, Roosevelt Steamship Company

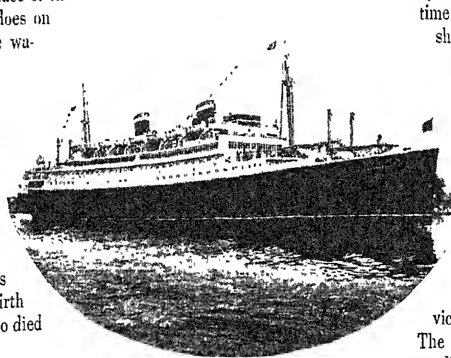
WE all know from our early study of geography that the earth's surface is only one quarter land—the rest is water. The thousands of miles that separate the divided portions of land have been crossed as far back as history is recorded. The type of vessel employed by "those that go down to the sea in ships" has changed over the years, but there has always been the one fundamental difference between water transportation and land transportation. A ship does not ride on the surface of the water as a wheeled vehicle does on land, but rather through the water.

My earliest recollection of firsthand information regarding travel by sea comes from the stories my old nurse used to tell me of her voyage from Ireland to New York. She had been my mother's nurse, and indeed had first come to my mother's family before my mother's birth to take care of the brother who died and after whom I was named.

In those days ocean travel was no luxury even for those who could afford the best accommodations obtainable. Of course the greatest degree of discomfort was decidedly among the slave traders of the North and South Atlantic and the "blackbirders" of the Pacific. Not much better were the accommodations provided for the convicts sent by Great Britain to her colonies. It was an excellent opportunity for a visual picture of just what these conditions were when the resurrected Australian convict ship made its tour of American ports not so many years ago.

During the days of the peak of immigration travel to this country, North Atlantic living conditions for the Steerage Class were far from good and these were not altered appreciably until shortly before the World War. The Steerage passengers were bunked as many as a hundred in one compartment as standees. There were two tiers of bunks and the traveler provided his own bedding. Of comfort there was none, and anyone who has made a rough channel crossing under the somewhat higgledy-piggledy conditions can to a small degree appreciate what a rough transatlantic crossing must have meant.

Great strides have been made toward the comfort of the passengers and in the main these are of very recent origin. Although they are most striking in the Third Class (formerly Steerage), where in the North Atlantic trade the standee is as extinct as the dodo, they are almost equally marked in every class. Even the lower priced ships carry an increasing proportion of rooms with baths and the time when you can get four people cheerfully to pay tariff rate while sharing an inside cabin without any running water is gone.



Not the largest, but more efficient. Our luxurious liner *Manhattan*

Formerly the dining salon consisted of a number of long tables where the passengers were automatically seated without any opportunity to express a wish with regard to their table companions. There was as little flexibility in meal hours as there was in the laws of the Medes and Persians. When a dinner gong rang, you appeared at table, and if you were late, you started in at whatever course the dinner had reached upon your arrival. Another inflexible regulation was that the ship permitted no woman to enter the smoking room. I have myself seen both of these rules in force within the last twenty years. Today the latitude assumed by the steamship company in seating and serving its passengers is as great as is observed by any first class hotel on land, and the demand for tables for two people must be heeded.

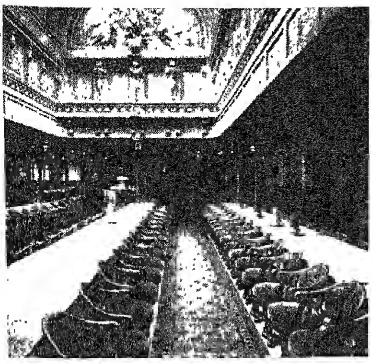
INDEED, the analogy of the hotel holds true throughout and the leading steamship companies are really running efficiently staffed and equipped ambulatory hotels. The department that looks after the comfort of the passengers must be as efficient as that which looks after the safety of the vessel and its physical propulsion through the water.

Equally great changes have come to pass in the speed and size of the vessels. When steam first entered the field of competition, it was as an accessory, and many a Clipper ship could make faster time than the contemporary steamship. As far as reliability of progress was concerned, the steamer could by no means be placed first. Many of us can remember the joy with which in the early days of automobiles we would pass by a stranded motorcar and shout out "get a horse." Many a captain of a sailing vessel may have found himself in a position to shout similar advice to a steam propelled rival.

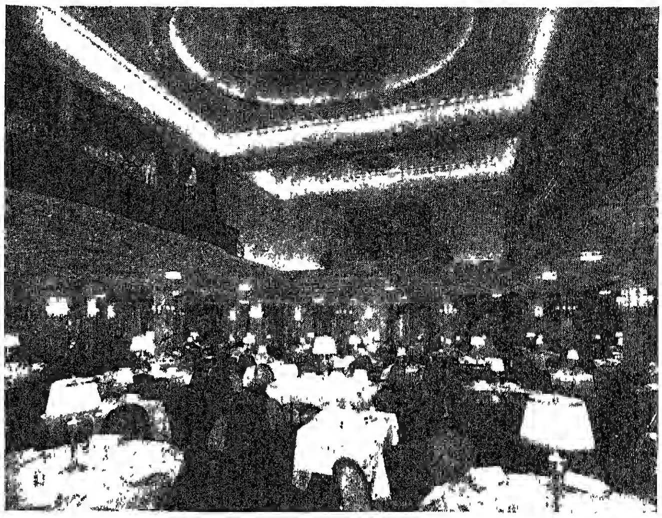
The modern science of designing ocean liners is hardly a century old, and as a matter of fact, the first vessel to make a transatlantic crossing with the aid of steam, while also assisted with sail, was the *Savannah* in 1819.

Quite naturally the period of proof has lasted much longer with the steamship, comparatively speaking, than it has with the automobile and airplane. The days of sail as a method of commercial transportation were slow to die, and indeed they have not even yet forever passed from the picture. The most important field in which they have survived has been in the Australia-European grain trade, and much lumber is still carried in sailing vessels. On the inter-coastal routes, particularly in South America and in the Far East and along the African Coast, sail still plays an important rôle.

The degree of speed did not increase with anywhere near the same rapidity on water as it did on land or in the air. The Blue Ribbon for a transatlantic crossing



vay of contrast—*above:* the First Class ıg room of the S. S. *St. Louis,* crack rican ocean liner of 1895; and *at right:* ıg salon of the modern S. S. *Washington*



is indeed a luxury. As is known to all, there is an economic speed at which a vessel can travel, and beyond that every additional knot entails a cost far out of proportion with its relation to the total speed. To illustrate: the most economical speed of a given ocean liner might be thirteen knots on 22.1 barrels of fuel per hour, which should be translated into maximum movement forward resulting from a given quantity of fuel. When we step up the speed of the ship, the additional cost per mile is in a far higher proportion. In other words, it would cost $1.90 per nautical mile at 15 knots consuming 27.2 barrels of fuel per hour, whereas it would cost $2.61 per nautical mile at 20 knots with a consumption of 49.75 barrels of fuel per hour.

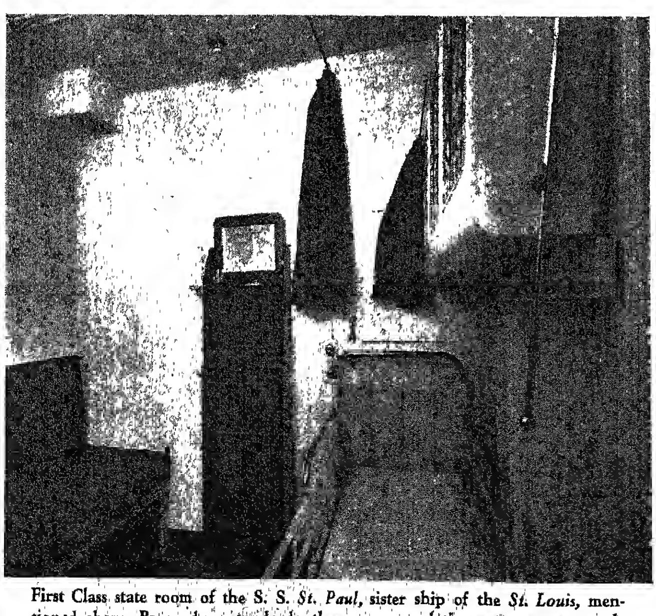
The transatlantic, or any other, Blue Ribbon is of somewhat intangible value to appraise. Before the War the *Mauretania* and the *Lusitania* called for admiration and envy with their speed. After the World War the Germans built the *Bremen* and the *Europa*, and quite justly capitalized on their achievement by every means possible. Since then the *Normandie* and the *Queen Mary* have made their appearances, but it looks as though some time would elapse before any new vessels would be launched to attack the speed supremacy of those already on the sea.

In matter of size it would seem as though we had for all practical purposes reached a definite limitation. In the first place, the initial cost of a monster liner is excessively high. Indeed, it is practically impossible for any private company to undertake one, securing the funds from the public, and economically justifying the expenditure. The government of a large country can, of course, afford to build vessels of colossal size, practically the only limitation being the capacity of ports of call. A government is also in a position to disregard the return on any investment without the necessity of explaining this failing at a stockholders' meeting.

It is easy to argue in either direction as to the value of a super-liner in demonstrating the supremacy in the realm of commerce of the nation of which it flies the flag. It is not so easy to justify its value as a naval auxiliary in time of War. This might be disputed from the angle of having so many eggs in one basket when the vulnerable area not only from the ocean surface, but from both below it and above it has so greatly increased. It is also obvious, of course, that there are only a limited number of harbors in the world capable of receiving the largest type of vessel, and even so, it is often necessary to await flood tide. This fact has often led to a misconception as to the definite saving of time in crossing on a super-liner. As a matter of fact, a large percentage of the traveling public seems to be equally, if not more, contented, crossing in ships of the type of the *Manhattan* and *Washington* which, while not offering the same speed, still afford a rapid passage and fulfill every requirement in accommodation and table.

WHILE the *Manhattan* and *Washington* are of 27,000 tons as compared with 70,000 ton monster liners, the difference in size has no effect with regard to comfort. The *Manhattan* and *Washington* offer every convenience required to the maintenance of the high standard of living to which we moderns are accustomed.

There will always be a certain percentage of travelers who go to one extreme or the other. Some like to feel that they are on the fastest ship, or the largest ship, and that they can make the whole crossing, weather permitting, without realizing they are not stopping at some gigantic hotel. Others, perhaps for atavistic reasons, want to feel more a part of the sea and prefer the smallest



First Class state room of the S. S. *St. Paul,* sister ship of the *St. Louis,* mentioned above. By modern standards, these accommodations appear very crude

vessel that will provide them with adequate comfort. A few days longer spent in crossing is to them an additional attraction. When they are walking the decks they want to know they are at sea and not hundreds of feet above the water where perhaps they can't even see it. Many passengers on such vessels as those of the American Merchant and Baltimore Mail Lines will tell you that they regard it as a yachting voyage, that they go to sea to be at sea, and that even if they are on a business trip, a few extra days amount to nothing to them in their work.

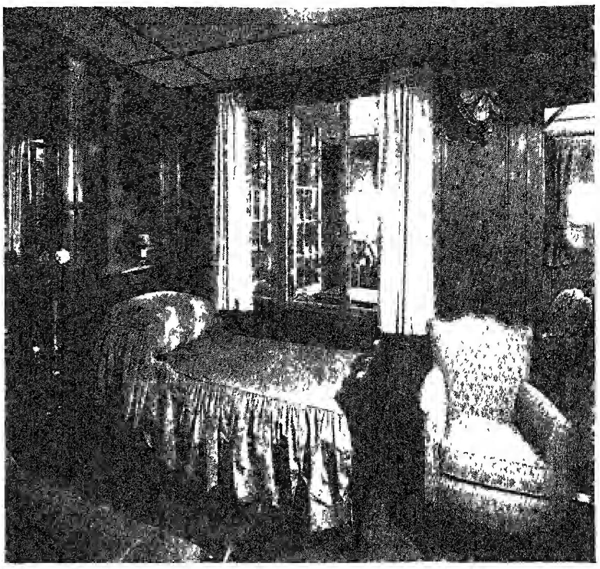
THE first great forward step in the creating of laws that provided for greater safety at sea was the bill introduced by Samuel Plimsoll in England in 1875. A permanent memorial to his memory appears on the hull of every ship in the form of a mark that indicates the limit to which a ship may be loaded, and this mark is generally known as Plimsoll's mark. Since his time there has been a constant increase in the number of safety devices and laws, the most exacting of the latter having been passed by our own United States at the last session of Congress.

The progress in safety devices of every sort has been incredible. First and foremost there is, of course, the radio, which is only 35 years old. In the old days, the only news received before the vessel reached sight of land was when some other ship "spoke" her and through faster speed or because she was going in a direction that would bring her to her destination quicker, was able to make a report in advance.

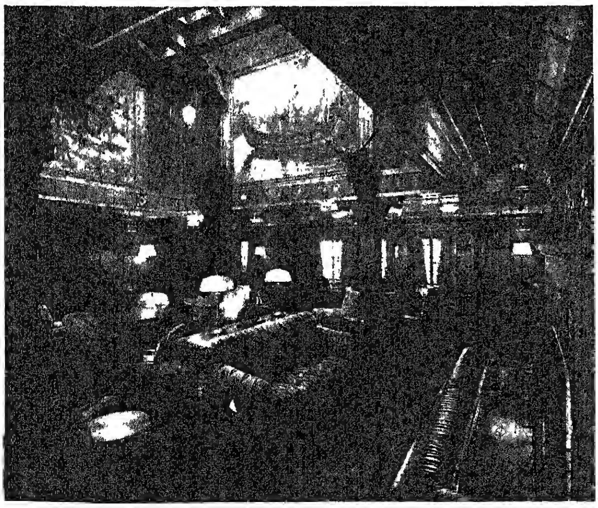
Many a vessel disappeared off the face of the waters leaving no trace. One of my own forebears set off on one of his ships which was never reported again. Such instances do occur today, but usually it is some small ship that is not equipped with wireless. We are now able to chart out a ship's progress with the utmost accuracy.

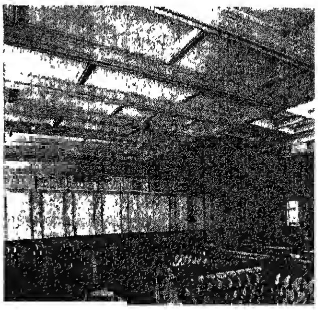
The Sperry gyroscope is a fairly recent development of very great value. The system of fire detection whereby direct connection with the bridge reports the start of fire in any portion of a ship adds greatly to the element of safety. The inception of a fire is far more unlikely since steel and iron hulls replaced wood, and even the wood-like parts of a ship are usually constructed of infinitesimally thin veneers of wood forming such a practically integral part of the steel or other non-inflammable substances, as to make it impossible for them to cause an outbreak of fire.

One of the most interesting fields for speculation does not fall in the province of this article, but steamship owners and operators, particularly where engaged in fast passenger traffic, may well spend much time in speculating as to what effect the airplane and lighter-than-air craft are going to have in the possibly very near future. We have had ample opportunity to study their effect on land transportation and are already being afforded a chance to envision their possibilities over the longest of open ocean stretches.



**One of the 12 charming period suites on the *Washington*, consisting of sitting room, bedroom, bath, foyer, and trunk alcove. This one is French provincial**





**Smoking room of the *Washington*, above, and of the *St. Louis*, at the right. The difference is obvious**

*A reminder of the article "Our Merchant Marine To Be" by the Hon. Daniel C. Roper, in our October, 1936, issue, seems particularly apposite. We quote: "I take it as a happy augury that the Merchant Marine Act of 1936 becomes effective at a time when we are rapidly emerging from the depression . . . it should give us, within the next few years, a strong and adequate merchant marine, capable of competing with the ships of any nation, and of meeting the demands of an expanded Navy in time of national peril . . . ship building programs will stimulate activity in the heavy industries, furnish maximum employment for American shipyards. . . ."*
—The Editor.

# A Relativistic Eclipse

## What Might be Seen from a Planet Conveniently Placed Near the Companion of Sirius . . . Perfect Tests of General Relativity that are Unavailable

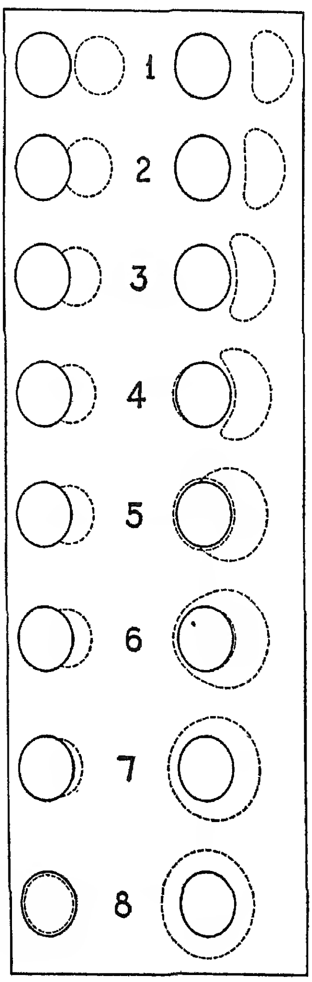
By HENRY NORRIS RUSSELL, Ph. D.

Chairman of the Department of Astronomy and Director of the Observatory at Princeton University, Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington, President of the American Astronomical Society.

IT is a familiar aphorism that the theory of relativity, despite its enormous importance, both in physics and philosophy, may be forgotten in ordinary practical life. There is a good reason. In almost every known case its results agree so closely with those of the older "classical" theories that very accurate observations are required to distinguish between them. Thus, for example, the famous Michelson-Morley experiment requires long series of the most careful measures. The three famous tests of the general theory (which includes gravitation in its scope) are of this sort. The advance of the perihelion of Mercury presents itself in observation as an increase above the much larger, but definitely calculable, amount due to the attractions of the planets. The bending of light rays which pass close to the sun is so small that it can be detected only by observations of stars in the field surrounding the totally eclipsed sun, employing a host of precautions to eliminate sources of error. The slowing of "atomic clocks," which reveals itself as a displacement of spectral lines toward the red, is so minute for the sun that its exact value can hardly yet be determined by observation. In all cases, the results of the best observations agree decisively with the theory of Einstein; but these observations themselves are triumphs of the art of exact measurement. Outside the solar system, the line-shift in the spectrum of a white dwarf star, like the companion of Sirius, is a little larger, but still small enough to demand accurate work to find its value. One related effect, however, is certainly not small—namely, the red-shifts in the spectra of the remoter nebulae. But, enormous as the change in the spectrum is, the nebulae which show it are so faint that even with the greatest telescope, their spectra remind one of Merlin's book of charms, written in "text no larger than the limbs of fleas"—and the shift, though great, can hardly be called conspicuous.

It is natural to inquire whether, under favorable circumstances, the effects of relativity could become more obvious.

For observers on earth, the answer appears to be in the negative. The most promising chance would happen if one star should pass exactly between us and another, so that the light of the more distant body, bent inward all round the nearer one by its gravitational field, might be brought to a focus. The consequences of such an event have just been worked out in detail by Professor Einstein himself.[1] From a point exactly in line, the distant star would appear to be expanded into a ring of light surrounding the other; but, at actual stellar distances, this ring would be too small to be resolved by even the greatest telescopes, and would escape our observation altogether, even if we were watching for it. The focusing effect, however, would concentrate the light of the distant star to a notable degree. For a star which appeared as a mathematical point, with no angular diameter at all, the increase in brightness would be infinite. But any real star must have a finite angular size, however small, and for such a star the increase in brightness, though it might be large, would have a limit.




If a bright star passed in front of a fainter one, its own light would drown out the effect; but if one of the faint red stars, which are really more abundant than any other sort, should get directly between us and a distant super-giant, like Canopus or Rigel, a really conspicuous brightening would occur.

The chances of such an event are, however, negligibly small. The notable increase in brightness happens only when the observer is distant but "a few light-seconds," as Einstein puts it—that is, a million miles or so—from the line through the center of the two stars. The chance that the earth would pass so very near this line is excessively minute. Even if it should do so, we would remain within the critical region for only about a day, and the rare phenomenon would probably be missed, unless previous observations of the approach of the two stars had warned us when to watch for it.

We earth-bound creatures, then, must depend for our tests of relativity upon refined measurement. Would this be true for observers anywhere in space, or would there be a better chance somewhere? By giving play enough to our imagination—for example, by creating, in our dreams, stars of enormous mass and density—we could get anything we liked. But this is begging the question. Let us make the more modest assumption that an observer, with observing powers and intelligence on the human level, could wander at will through the starry heavens. Give him a planet to live

[1] See *Science*, Vol. 84, No. 2188.

on and let him locate it at will, without bothering too much about its atmosphere, temperature, and the like; but let him be confined to observing, from his chosen viewpoint, the real stars, about which we actually know. Could our imaginary space-tourist locate his planet so that the effects of general relativity would at times become conspicuous to the immediate gaze, without taking the trouble to make measures?

THERE is no hope of doing this with the motion of a perihelion, or with the shift of spectral lines—indeed, we can now observe the latter, in the spectra of white dwarfs, as well as we could if we were nearer. But the deflection of light passing close to a star is more hopeful. The amount of this, for a ray just escaping the star's atmosphere, is proportional to M/R—the mass divided by the radius. To get a large deflection we need large mass and small radius, and we shall do best with a white dwarf. For the companion of Sirius, for example, Milne concludes that the mass is 95 percent of the sun's, and the radius 1/37 (11,700 miles). This makes the deflection 35.2 times as great as for a ray grazing the sun (1″.75), or 61″.6. The "focal length" at which originally parallel rays grazing the body on both sides would meet comes out as 3350 radii of the star, or 39,000,000 miles. (For the sun the corresponding distance is 51,000,000,000 miles.) To get the most remarkable effects, we should put our planet a little farther away than this, so that rays grazing the surface of the white dwarf will cross behind it. Let us place it so that the apparent radius of this star is 50″. Its distance will then be 48,300,000 miles, or 0.52 astronomical units, and, by Kepler's Third Law, its period of revolution will be 140 days. Seen from this distance, the companion of Sirius would be a brilliant object. It would be of 1/19 the sun's apparent diameter. Since it is hotter on the surface it would send the planet about 1/100 as much light as the sun sends the earth—quite enough to light it up, though not sufficient, of course, to keep it warm.

To complete our attempt, we must have something else which can get behind the companion and have its light deflected, and yet be bright enough to be seen in the glare. Sirius itself is just what we want. According to Milne, its diameter is 1.54 times the sun's, while the well-determined orbit and parallax show that its distance from the companion varies from 8.4 to 32.4 astronomical units. Adding 0.52 more to allow for its being seen from our planet when an eclipse is imminent, we find that the angular radius of Sirius would be 166″ when nearest, and 45″ when farthest away. In the first case, we would have a transit of the companion across the far larger disk of Sirius, but in the second, if there were no gravitational deflection of the light rays, Sirius would appear to be only 9/10 the size of the companion, and the eclipse would be total. According to the spectral types, Sirius is somewhat hotter than the companion, and should shine more brightly for equal area—so there would be less than no difficulty about seeing it. Eyes like ours would need dark glasses to cut down the glare, and a moderate telescopic power to reveal the disks (which would look about twice as big as Jupiter does from the earth).

**FOR the benefit of those who are further interested, Professor Russell states that the drawings on the opposite page were made as follows:**

**Let $D$ be the distance of the planet $P$ from the companion $B$, and $AB$ ($=62.3D$) the further distance to Sirius. A ray starting at $P$, at an angle $x$ seconds of arc to the axis, deflected by $y$ seconds near $B$, and carried back to $A$, will be at a distance from the axis $63.3D\ x \sin 1'' - 62.3Dy \sin 1''$. Seen from $P$, this distance will subtend the angle $z = x - 0.984y$. Now $y = 3080/x$ ($61.6''$ if $x = 50''$). Hence $z = x - 3030/x$. Plot this curve; read $z$ for any point on a diagram of geometrical eclipse; lay off the corresponding $x$ on the line through the center of $B$.**

We must still make sure that eclipses will happen; but as our planet is an imaginary one, we must just set it moving in the plane of the orbit of the wide pair, in which case there will be 190 eclipses during every revolution of the latter in 50 years.

It is now perfectly easy to calculate just what the eclipse of Sirius by the companion would look like, when seen from the planet at the time when the stars are farthest apart. The results of a fairly careful calculation are shown in the figures. The left-hand diagram in each pair shows what would be seen if there were no relativistic deflection of light. The succession of events is commonplace—very much like a total eclipse of the sun, except that the difference in size of the two disks is greater. The right-hand figures, in which the Einstein effect is taken into account, are remarkable. In Figure 1, where on geometrical principles the stars would be approaching contact, the bending of the rays makes the two disks seem to be still widely separated. Since this is greatest for the rays which have passed nearest the eclipsing body, Sirius is conspicuously distorted and, since the deflection takes place radially outward from the center of the companion, Sirius appears to be enlarged vertically. Similar, but smaller, effects would have been visible some time earlier in the eclipse.

In Figures 2 and 3 the geometrical eclipse has advanced until a considerable part of Sirius is hidden behind the companion; but the deflected image, though increasingly distorted and enlarged, is still clear of the other.

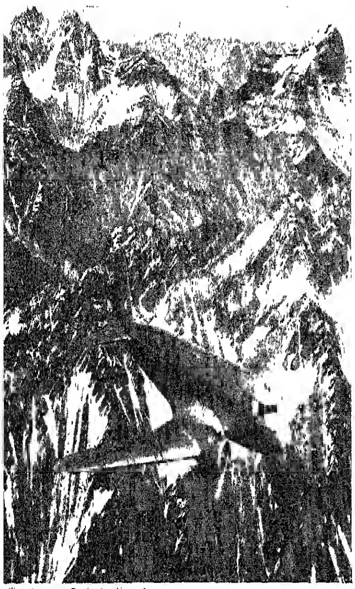
In Figure 4 the distortion is very great; and a bright crescent has appeared on the *opposite* side of the eclipsing disk. This is produced by light coming from the part of the geometrical disk of Sirius nearest the center of the companion and deflected around the far side of the latter.

FIGURE 5 shows the situation when, geometrically, the edge of Sirius just passes through the center of the companion. The original distorted image has developed pointed horns, while the narrow crescent has grown and shot out horns to meet them. After a short time we have Figure 6. The two parts have coalesced to form an irregular ring completely surrounding the eclipsing disk, while, on the other side, a narrow dark crescent appears. This represents the region where rays grazing the eclipsing companion are so much deflected that they strike the sky outside the disk of Sirius.

In Figure 7 this crescent has vanished, and Sirius appears as a ring surrounding the companion, while in Figure 8 for central eclipse, it looks like an annular eclipse of a large disk by a small one, instead of the actual total phase. From this point, all the previous phases occur in reverse order. The most remarkable changes, Figures 4, 5, 6, would appear rapidly. The advance of our planet in its orbit from each to the next is only 5″. With a period of 140 days, this would take 47 seconds of time, by our reckoning.

Our hypothetical space-tourist, therefore, could settle down with his planet in such a place that general relativity would no longer be a matter of the utmost refinement of theory and observation. It would instead be needed to account for the most bizarre and spectacular phenomena of the heavens, as he saw them. No other place in all the known universe would give him the same opportunity. One other white dwarf is double; but its companion is faint and red, so that it could hardly be seen at the time of an eclipse. Should he be near an isolated white dwarf we would have to invent a moon to eclipse it, and let him photograph stars around it (as we do here on our own planet).

My hearty thanks are due to Professor Einstein, who permitted me to see the manuscript of his note before its publication.—*Princeton University Observatory, December 2, 1936.*



Illustrations courtesy Pan American Airways, Inc.

Over the Andes. A 14-passenger Douglas in service in South America

# THE RISE OF AIR TRANSPORTATION

**Past . . . Present . . . Future . . . Air Mail Reaches All Five Continents . . . World-Wide Development . . . Catapults May Become Important**

By REGINALD M. CLEVELAND

TWENTY-FIVE years ago the first sack of airmail was carried from Nassau Boulevard to Mineola, a distance of ten miles. Today, airmail reaches all five continents; a letter mailed today in New York will be delivered in Buenos Aires in five days, in Hongkong in six, or to any major city in the United States before the business of tomorrow gets underway. This year, first-class mail will be carried by flying boat from England to the remote corners of the British Empire at ordinary postage rates. There are 28,000 miles of airways in the United States over which, day and night, under clear skies and in storm, the airmail is sped at cruising speeds which approach 200 miles an hour. About fifteen million pounds of airmail traveled the skyways of this country in 1936.

The route mileage of the world's airlines now approximates 300,000 miles. This enormous network has been spun in less than 20 years. In the first year of true commercial air transport, 1919, only about 3000 miles of routes were in operation. On these routes the pioneers of air transport of today flew about a million miles. In five years the figure for miles flown was multiplied by a little more than eight, and from 1925 on, the rate of progress continued to increase. Figures recently compiled by the British Air Ministry tell the story of this growth.

| *Year* | *World Air Route Mileage* | *Miles Flown During the Year* |
|---|---|---|
| 1925 | 34,000 | 13,011,000 |
| 1926 | 48,500 | 16,824,000 |
| 1927 | 54,700 | 22,242,000 |
| 1928 | 90,700 | 34,005,000 |
| 1929 | 125,800 | 53,379,000 |
| 1930 | 156,800 | 69,505,000 |
| 1931 | 135,100 | 83,500,000 |
| 1932 | 190,200 | 90,872,000 |
| 1933 | 200,300 | 100,580,000 |
| 1934 | 223,100 | 108,432,000 |
| 1935 | 278,300 | 149,342,000 |

The past year saw immense new additions to the airway map in the Far East, in Russia, in China and, most spectacular of all, the opening of the wide Pacific as a road of the air which alone added some 9000 miles to the existing air-transport routes. The year also saw accomplished services and interesting experiments in the Atlantic.

With a regularity and a success which confounded utterly the opponents of lighter-than-air, the airship *Hindenburg*, the world's largest rigid, made 20 scheduled crossings of the north Atlantic, linking New York through the naval air station at Lakehurst and Frankfort in a service which averaged less than three days westbound and about two and a half days eastbound. The Germans also made successful exploratory flights in this field using airplanes with a mother ship after the method which they had found so successful in the south Atlantic. From a small vessel, the *Schwabenland*, converted for the purpose, the Dornier-18 flying boats, *Zephyr* and *Aeolus*, were catapulted to make non-stop flights in both directions between the Azores and New York, Bermuda and New York, and Nova Scotia and the Azores. Neither passengers nor mail were carried so that the flights must be regarded wholly as experimental, which was their announced purpose, but they served as a herald of actual mail service to come.

With a safety record which, despite a few spectacular disasters, has on the whole been most encouraging, the domestic airlines carried close to a million passengers in the United States last year. They increased the number of their schedules, they somewhat augmented their already high speed and they put in service airplanes of advanced design which offered a new degree of comfort and roominess.

Both the day and night versions of the Douglas *DC-3* took to the air. Already 64 of these large ships have been constructed or are on order. In the sleeping plane version they accommodate from 14 to 20 passengers in spacious and comfortable berths. American Airlines has put them into service in this form on its southern transcontinental route. It has also employed one of the day versions of cabin arrangement in which the plane seats 21 passengers for non-stop flights between New York and Chicago and between New York and Boston. For this company, power is furnished by two 1000 horsepower Wright Cyclones.

United Air Lines placed in service the same type of plane powered with 1000 horsepower twin-row Wasps. Some of the 28 ordered have a different cabin arrangement in which only 14 completely revolving and adjustable chairs were installed, leaving an exceptionally large and roomy lounging area. Others are 21-passenger day planes; eight 14-passenger sleepers. These big monoplanes, of which some are also on order for TWA and Eastern Air Lines, show new advances in appointment and soundproofing and the pilots flying them speak very well of their handling qualities.

In the Pacific, the Martin *Clippers*, after pre-view flights, began their regular passenger schedules on October 21st. They carried the house flag of Pan American, already familiar in the countries and colonies of the West Indies and Latin America, in China and Alaska, to Hawaii, the atolls of Midway and Wake Island—ready, cap-a-pie, with 40-room hotels—to Guam, Manila, and Hongkong.

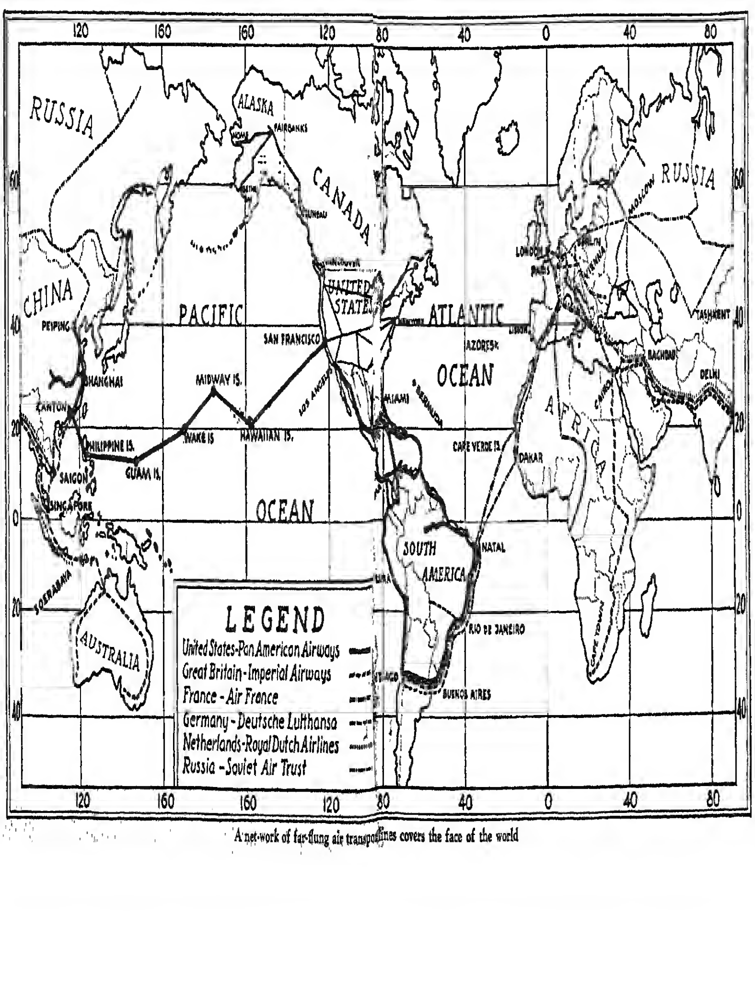
Sikorsky *S-43* amphibians and Douglas *DC-2's* brought new speed and comfort to the lines of Pan American-Grace in the Canal Zone and along the high breastwork of the Andes on the west coast line in South America. Shorter lines in the United States, like Northwest, Chicago and Southern, Delta, Central, and Braniff, stepped up their service with Lockheed Electras.

Abroad, fast new transports appeared on the lines of Air France, in Italy, and in Germany. They were 14 to 18 passenger bi-motors, much on the pattern of the clean American designs, which brought entirely new cruising speeds to European transport.

IN Great Britain, the first of the Empire boats were launched. This fleet of Short flying boats will knit the Dominions and colonies more closely than ever before. Troublous times in Europe and the threat of political difficulty along her far-flung routes convinced Britain that she must once again take to the sea for safety and an unbroken thread of communication, so that her citizens and her mails could fly to the far reaches of her domain without the necessity of crossing alien land.

Of these 18-ton boats, the majority will be used on the African, Indian, and Australian routes; one will be shipped to the United States, assembled here and used in experimental service between New York and Bermuda. Another, stripped of elaborate passenger accommodations, including berths, and fitted with extra tankage, will be used for exploratory non-stop flights between Ireland and Newfoundland.

Important as they have been, the de-




A net-work of far-flung air transport lines covers the face of the world

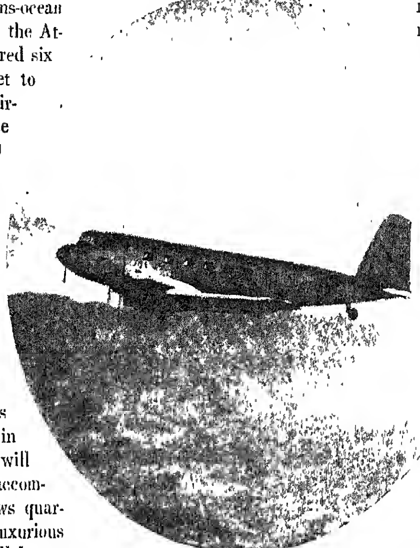
velopments of 1936 in air transport are, however, but the prelude to much more startling advances which may be expected this year and next.

It has been clearly demonstrated that size is no bar to the efficient operation of heavier-than-air craft. True of land planes, given adequate airports, it is true even in a more unlimited sense of flying boats. Aircraft now on order and under construction plainly reflect the trend to larger size. For its trans-ocean service in both the Pacific and the Atlantic, Pan American has ordered six of the largest flying boats yet to be built from the Boeing Aircraft Company at Seattle. These giants will have a span of 150 feet, a gross weight of 82,000 pounds and capacity for 60 passengers, or 40 in berths by night. Speed is expected to be in the neighborhood of 200 miles an hour, and range 4000 miles. High-wing monoplanes of all-metal construction, they will resemble the Martin *Clippers* in that they will use stub wings or sponsons for stability when on the water in place of wing tip floats. There will be two full decks, the upper to accommodate the control cabin, crews quarters and galley, the lower for luxurious passenger accommodations. Still larger boats are in the offing.

The Douglas *DC-4*, joint creation of five of the major airlines and the manufacturer, nears completion. It may even be in the air for test by the time this issue appears. It marks a great advance, not merely in range with load, but in real spaciousness, over anything yet attempted in a land plane. The berths for 20 passengers are wider and longer than those of a sleeping car. Some can be made up into double berths, while between compartments small curtained corridors become miniature dressing rooms. The pilot's compartment, carried as a sort of high bridge in the nose, is noteworthy for vision and for a convenient grouping of instruments. The Sperry automatic Gyropilot controls, for example, are immediately at hand below the wheels. A comfortable swivel chair for the navigator-captain enables him either to work at a table behind the pilots, or swing himself into a position directly behind and between them.

THE scale of these great machines is so large that it has become possible to generate 110-volt electric current from independent small engines housed in the wings rather than to put the great strain on the battery and generator involved by the many electric accessories. The plane has a span of 140 feet, length of 95 feet, and an overall height of 20 feet.

Performance figures, of course, are not yet available, but judging from other Douglases which have been built to specification, specified performance is altogether likely to be met in the *DC-4*. This would give it a top speed of around 230 miles an hour and a range with load of 2000 miles. One of the clauses of the book of specifications, which is a fat volume, requires takeoff with full load in a run of 3000 feet when any one of



the four engines has been cut 1000 feet after the start of the take-off.

This giant transport is only immediately around the corner. A little farther ahead lies the promise of very interesting developments, not only in the extension of plane scale, which must go hand in hand insofar as land craft are concerned with the development of better airports—especially the development of landing strips of sufficient solidity and base to withstand the shock load—but also as to application of new technique to flight, especially at high altitudes.

Various airlines are making engineering studies of the feasibility of high-altitude operation with large transports. If this is demonstrated the lines will co-operate in the development of an experimental airplane which might well cost one million dollars. Lieutenant Commander D. W. (Tommy) Tomlinson has been making test flights for TWA up to altitudes of 35,000 feet in an especially equipped Northrup *Gamma*. He and his associates are making studies of oxygen and pressure requirements.

Operation at these high levels obviously means pressure cabins as well as supplementary oxygen supply. What the aircraft will be remains to be ascertained. However, it is an open secret that the Curtiss-Wright Corporation has gone far with studies and mock-up of a four-engined, pressure cabin transport of very large size, suitable for sleeper equipment and probably for two-engine cruising when the upper levels are reached. It is also understood that the Glenn L. Martin Company and at least one other important builder have gone far with studies of pressure cabin planes, of which no details have as yet been revealed.

It is reliably reported that Luft Hansa is planning a series of experimental flights over the north Atlantic next summer. This work will be done with flying boats powered with four Diesels. Although details are lacking at the time of writing, the results will be awaited with great interest.

Great Britain is about ready to try its bold and interesting experiment with the Mayo composite airplane, in which a carrier plane with light wing loading will take aloft to a suitable level a heavily wing-loaded mail plane and act as a flying catapult by giving its parasite, as it were, sufficient flying speed to get away with a load which it could not, under its own power alone, safely lift from the ground.

There are many who believe that this undertaking, while very intriguing, involves difficulties which could be more easily overcome by the extension of the catapult idea on the ground. Indeed, it seems highly probable that this method of launching will find itself applied not merely to the military aircraft, the small mail planes of ocean liners, and the somewhat larger flying boats, such as the *Zephyr* and *Aeolus*, but to the very large transport types which have been discussed in the preceding paragraphs.

IT is contended that by having a long catapult run which, however, need not be nearly as long as runways on major airports, heavy loads, including passenger loads, can safely and surely be launched without the discomfort of too great acceleration and shock. There is reason to believe that the modern example of the ancient weapon which served, with its hurled stones, to breach the walls of cities, may be the medium for giving huge craft with their loads of passengers, mail and freight to their natural medium, the air.

Amazingly rapid as have been the strides of air transport, which is but little more than out of its 'teens, there can be no doubt that the surface has only been scratched. This year, passengers will know new speeds, new regularity of operation, new comfort. In the next decade, they will see development, both in aircraft themselves and in their method of use, more spectacular than any of the history-making exploits which have gone before.

# PROGRESS ON RAILS

## Railroads Alert to Problems . . . Look Ahead . . . Build for Efficiency, Safety, Comfort, Speed . . . Constant Research Meets Modern Demands

By J. J. PELLEY
President, Association of American Railroads

GUIDED by their experiences of the past but geared to the tempo of the present streamlined age, the railroads of this country are now in the midst of a new era of development. From it are emerging continued improvements in all phases of rail transportation which are giving the railways a new importance in the commercial and economic development of the nation.

Ever since the first railroad was built in this country, improvements have continued to be made to locomotives, cars, and roadbed, and in methods of operation. Railroad managements have always been alert to the advantages that come from such improvements. Had it not been for the progressive policies adopted by railway managements in the past, many of the developments now being made would have been impossible.

In this new era of railroad development, however, science is playing a greater part than ever before. Through the scientific microscope the whole transportation picture is being carefully examined with the purpose of ascertaining what further improvements can be made that will best serve the public and the rail carriers themselves. Before any change is made, however, each one must undergo a test as to what effect it will have on safety, comfort, dependability, economy, and efficiency.

THE railroads, in 1923, adopted a program calling for the furnishing of an adequate transportation service to the shippers of this country. In accordance with that program, arrangements were perfected for the necessary co-operation between the railroads themselves and the shipping public, and also for expenditures required in order to provide adequate additions to existing facilities with a view to bringing about greater efficiency and economy in operation.

Under the stimulation of that policy, the railroads not only successfully met the heavy traffic demands of the pre-depression years but later years as well. At the same time, they have steadily continued to improve their efficiency and economy in operation. As a result, the people of this country are today being furnished with the cheapest, safest, and most dependable rail transportation to be found in the world. To produce transportation which can be sold at a price averaging less than one cent for hauling a ton of freight one mile is an achievement in management, operation, and research.

Installation 40 or 50 years ago of automatic couplers, air brakes, electric lights, and the many other improvements made up to 1920 were important. They added greatly to safety and efficiency in operation. Those changes, however, did not have the appeal to the public favor that has come from air-conditioning of passenger equipment, operation of streamlined passenger trains and locomotives, changes in the interior arrangement of passenger equipment which add to the safety and comfort of the traveler, speeding up of both passenger and freight service in general, and many other improvements which have been made in recent years by the railroad systems of this country.

The increase that has taken place in the past five years in the speed of passenger trains is without parallel. More than 400 trains using steam, internal combustion, or electric power, and covering in excess of 19,000 miles, operated on schedule runs timed at 60 miles an hour or better at the beginning of 1936. Since that date, further increases in many instances have been made. In 1930 there were only 30 regular runs, covering a total distance of 1100 miles, which operated at 60 miles an hour or higher. By this increase in the speed of trains, distant points are being brought closer and closer together.

So far as benefits to the public are concerned, the remarkable improvements made in freight service in recent years are of far greater importance. Freight trains on many railroads today operate virtually on what were once passenger train schedules. Over-night delivery of freight from points as far away as 400 miles and more is common in many parts of the country. This means that from one terminal to another, including time occupied at intermediate points, many of these freight trains must average more than 40 miles per hour. This general acceleration of freight-train movements stands out as one of the most noteworthy improvements in railway service. By reducing the running times between important centers, substantial reductions have been made possible in investment in stocks on shelves and goods in transport. The distance between business localities has been shortened from the standpoint of time.

FREIGHT moving from Chicago and St. Louis, for instance, now arrives in New York for third morning delivery compared with six or seven days required for a freight shipment some years ago. Six years ago the fastest regularly scheduled freight train between Chicago and New Orleans made the run in 55 hours. Now the southbound run is being made in 41 hours and the northbound run in 38 hours, although banana and fresh fruit trains make it northbound in considerably less time.

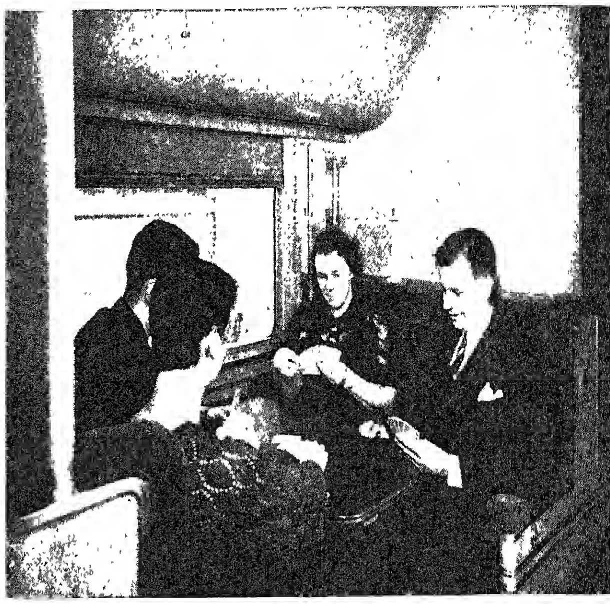
From the Pacific Coast cities to Chicago, Omaha, and Kansas City, eastbound freight schedules generally have been reduced about 24 hours in recent years, while fruit shipments from California destined to eastern points are now handled on an expedited schedule which is about 30 hours faster than in 1930. The schedule for freight traffic from Denver to Chicago has been materially reduced. Livestock at the present time, for instance, arrives in Chicago for unloading within the 36-hour law, doing away with the necessity of unloading it *en route* at least once for feed and rest. Perishable and other carload traffic from Denver is now transported on freight trains which give second morning delivery in Chicago.

Between Kansas City and Cleveland, St. Louis, and Buffalo, the running time of freight trains has been reduced by 24 hours, which enables the delivery of freight on the second morning; while between Chicago and Cleveland the shipper now receives over-night service. From Florida, the time required for transporting carload lots to Philadelphia, New York, Boston, and other northern cities is now 48 hours less than five years ago.

Not only has the average speed of

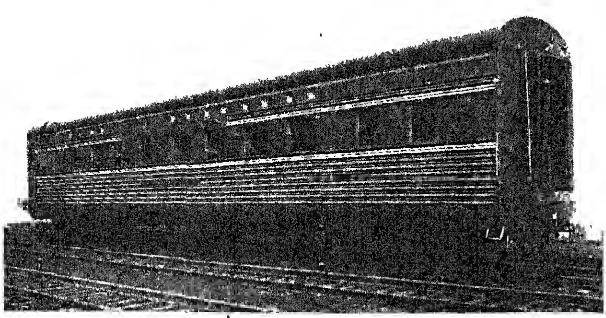
freight trains throughout the nation been increased by 55 percent since 1920, but there also has been an increase in the amount of freight carried per train.

Remarkable improvements in locomotive construction have been made in recent years. The effect of these improvements has been to increase the tractive power without a comparable increase in weight or fuel consumption. An indication of the results obtained through this improvement is the fact that in 1935, for each ton of coal consumed in freight service, the railroads hauled 8⅓ gross tons one mile. This was an increase in fuel efficiency of 44 percent compared with 1920 when the average was 5¾ tons. This increased efficiency in fuel consumption has resulted in a substantial saving in the amount of money expended for fuel by the railroads.



The latest in Pullman sleeping cars. It is constructed of light weight steel alloy on a truss frame and has numerous new comfort features. Note the wide window

MANY railroads today have in operation in their passenger service locomotives which can maintain sustained speeds from 80 to 90 miles per hour and are capable of running for some distance at from 100 to 110 miles an hour. Numerous railroads have increased the size of their locomotive tenders in order to reduce the necessity for frequent stops for water and fuel. One large eastern railroad is using a locomotive tender which has a capacity of 30 tons of coal and 25,000 gallons of water, which enables that road to operate heavy passenger trains a distance of approximately 300 miles, and heavy freight trains a distance of about 250 miles before it is necessary to replenish the supply of coal and water. Due to the improvements that have been made in locomotive construction, steam locomotives in passenger service in many parts of the country now travel 500 miles or more before they are replaced with fresh locomotives, whereas some years ago they were changed each 100 or 150 miles.



In appearance, the new Pullman car offers a contrast to those now in common use. It has eight sections, two bedrooms, and two compartments en suite

Experiments are now being conducted by the Association of American Railroads and by individual roads to determine which of the more than 10,000 steel alloys developed in recent years is most suitable for railroad use. Four years ago, after extensive experiments, a new type, light-weight, steel car was adopted as standard by the railroads of this country. A newly designed box-car made of alloy steel and weighing approximately 8000 pounds less than the standard car adopted four years ago is now being subjected to a series of rigid tests to determine its suitability to meet present-day operating conditions.

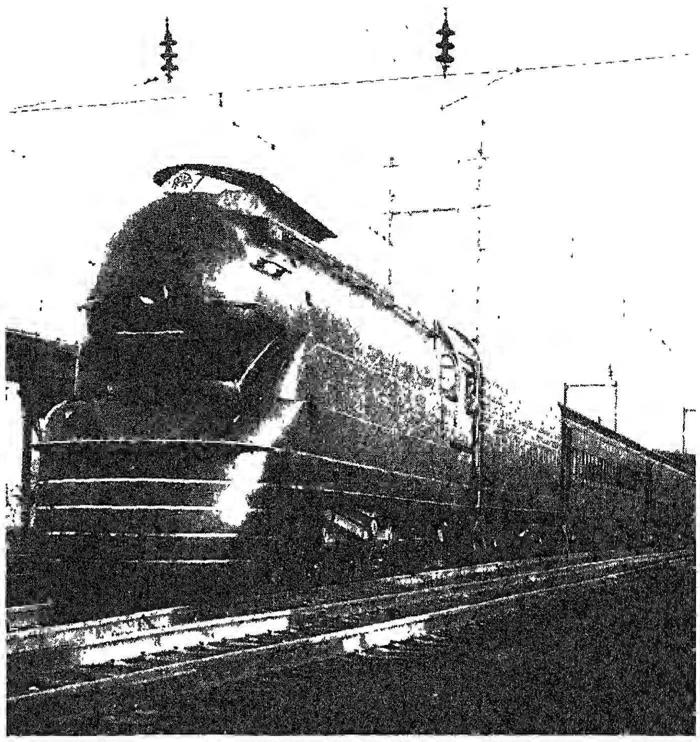
One of the most important research activities now being conducted is that sponsored by the railroads of this country and the leading steel manufacturers in an effort to ascertain what can be done to bring about a still better quality in steel rails. As a result of extensive experiments so far conducted in the laboratories of the University of Illinois, where the tests are being made, there has already been a marked improvement.

These experiments have shown that in some of the rails which have been examined there are small imperfections called "shatter cracks" which are located in the head of the rail. These shatter cracks are so narrow that one hundred thousand of them side by side would not extend more than an inch.

One of the large number of modern freight cars of light weight built by the Baltimore and Ohio Railroad for more efficient and speedier handling of freight. It is sheathed with steel and is lined with Masonite compressed wood board

Tests have developed the fact that an excessive load on a rail may cause these shatter cracks to grow into a transverse fissure which, to a rail, is comparable with a cancer in the human body. One way to produce shatter cracks under controlled conditions in the laboratory, according to these tests, is to heat a piece of steel in hydrogen and then let it cool in the open air. By controlling the temperatures of steel rails after they have emerged from the rolling mills, it has been demonstrated that shatter cracks can be prevented. As a result, a method of regulating the cooling of rails has been adopted by the rail manufacturers and a better quality of rail is now being produced at only a slightly increased cost.

Some years ago an apparatus was invented which locates transverse fissures at a relatively early stage of growth, but no method has so far been developed by which the minute shatter cracks in a steel rail can be detected without destroying the rail. Development of some means of ascertaining whether a steel rail has shatter cracks is now being carefully studied at the University of Illinois.

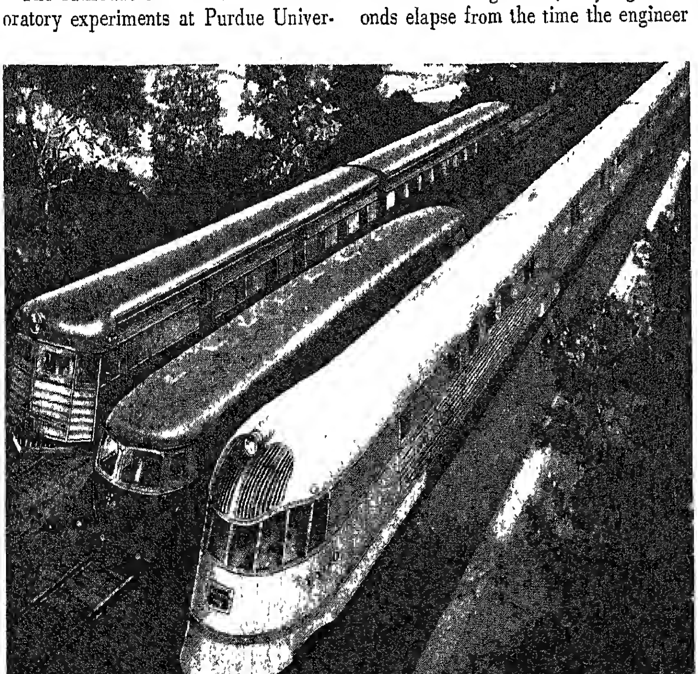


The Pennsylvania Railroad's contribution—a steam streamliner

In connection with this investigation, research work is also being conducted to ascertain the practicability of hardening the ends of rails in order to reduce the wear at the joints where it is the most severe. Some years ago the standard length of the steel rail was 30 feet but was later increased to 33 feet and a few years afterwards was increased to 39 feet. By increasing the length of the rail from 30 to 39 feet, the number of joints was reduced 23 percent.

The railroads conduct extensive laboratory experiments at Purdue University to ascertain what improvements can be made to draft gear, the mechanism just behind the coupler that absorbs the shock of starting or stopping of trains. As a result of these continuing tests an improved draft gear is now being used.

The railroads, about 10 years ago, initiated a long series of laboratory and road tests of air brake equipment. These tests cost more than 2,000,000 dollars and extended over a period of years. With this improved air brake now being installed in freight cars, only eight seconds elapse from the time the engineer operates his brake valve until the brake sets on the last car, sometimes as much as a mile and a half away. This can be shortened in the case of emergency brake applications.



Three typical trains of the new, fast, streamlined type

The Association of American Railroads is now just completing an investigation of air-conditioning of passenger equipment to determine what improvements can be made in the methods now in use by the principal railroads throughout this country, and also to what extent these systems can be standardized and the cost of installation and operation reduced. The result of these tests has not so far been determined.

Enumeration of the many improvements which the railroads have made in recent years, and which have brought about better service to the shippers and increased efficiency and economy in operation, could go on indefinitely. The general effect of the results which have been obtained can best be shown, however, by the fact that in 1935 the operating cost of moving 1000 tons of freight a distance of one mile was $6.63 compared with $10.78 in 1920.

The railroads are not content to rest on their laurels. Where improvements are possible they want to make them. While, in my long railroad experience, I have always found railway managements receptive to ideas and anxious to develop those that can stand the practical test, I have never seen them work with as much zeal as they are working today in their effort to make the rail transportation industry the greatest example of efficiency to be found in the world.

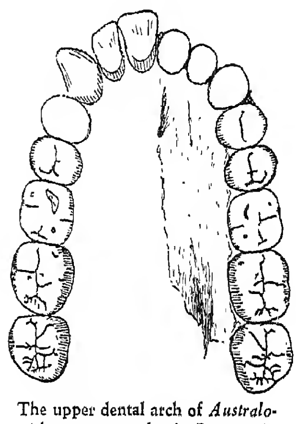
# FURTHER LIGHT ON MAN'S ANCESTRY

ABOUT a dozen years ago Prof. Dart of Johannesburg startled the world by announcing the discovery of a new type of anthropoid ape the skull of which had just been found fossil in a cave at Taungs near the southwest corner of the Transvaal, South Africa. The skull, which shows the face in almost perfect condition, is that of an ape-child of six years. Photographs, figures and restorations of this remarkable skull have appeared in Scientific American [August 1929, pages 119-122.—*Ed.*] and in various other publications, and are to be found in most textbooks on anthropology.

Prof. Dart considered that the little ape in its relationships came nearer to man than to the chimpanzee or gorilla. The brain he estimated to have had a volume of over 500 cc, and he thought it probable that an adult might have had a brain of 750 cc—not so very far below the lowest known human brain of 950 cc. He also believed that the shape of the brain indicated that the little ape was approaching man in walking much more erect than do any of the living apes, and that the little Taungs ape was very near to man's ancestor and to be thus the long looked for "missing link." Some scientists both in Europe and America considered that Dart had claimed too much for his little ape, and that it is only a variety of chimpanzee. When Dart, however, later removed the lower jaw and was able to display the crowns of the teeth it was seen that the milk teeth of the little ape-child are in structure exactly like those of human children and not in the least like those of the chimpanzee or gorilla. Gregory of New York considers that in nearly every dental character *Australopithecus*, as the little ape has been called, agrees with man and differs from the chimpanzee; and Romer of Harvard, who examined the skull in 1929, has stated that, whatever the affinities of the ape, it is "certainly not a chimpanzee or a gorilla."

Still, as the skull is that of a very young child and the infantile characters are a little deceptive, many have considered it safest to suspend judgment until an adult specimen could be obtained.

Early in 1936 I commenced an exploration of the limestone caves of the Transvaal, in the hope of finding further evidence of *Australopithecus* and of possibly finding remains of primitive man; in any case I was certain of finding many new extinct types of mammals. So far I have found no traces of man, but I have discovered over a dozen new species of fossil mammals, some of which belong to new genera. Then, about the middle of August, on a visit to the caves at Sterkfontein near Krugersdorp, Mr. G. W. Barlow, the manager of the limeworks, gave me the brain cast of an anthropoid ape that had been blasted



The upper dental arch of *Australopithecus transvaalensis*, Broom. As shown it is three fourths natural size. The sockets of the left incisors and canines are shown as preserved. On the right side the incisors and canine are restored. The exact width between the posterior molars is uncertain but the restoration is probably nearly, even if not wholly, correct as shown

out a few days before. I had asked him the previous week to keep a sharp lookout; and as he had been employed at Taungs when the Taungs ape was discovered, he knew exactly what I was after. A two days' hunt with a considerable party of assistants resulted in my finding in the debris the nearly complete base of the skull and much of the cranial wall. In the matrix by the side of the base of the skull there were later found detached both upper jaws with beautifully preserved teeth, and the third right upper molar tooth was also found detached.

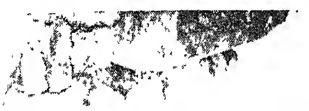
When all the remains were cleaned out it was seen that we had the nearly complete skull with only the lower jaw missing. As, however, the face is not in contact with the brow, there is a little uncertainty as to the angle the face should make with the top of the head. Still, the side view of the skull given in the figure must be nearly correct. If this be compared with the skull of a chimpanzee it will be seen that the brain case is rather larger and rounder and that the supraorbital ridges are less developed, and that the face is a little less simian. The front view of the skull is also not unlike that of the chimpanzee, though the face is a little more refined.

All photographs by Herbert Lang

The cave at Sterkfontein where the fossil anthropoid ape was found. Most of the roof has been blasted away. Dr. Broom is sitting on part of the floor of the cave with his left hand on the spot where the skull lay. The cave deposit is only about three feet thick. The upper and lower rocks are dolomite

# The Fossil Ape Newly Found in South Africa is Probably Closer to Man than the Living Apes

By R. BROOM, F.R.S.
Transvaal Museum, Pretoria, South Africa



Side view of the right upper 2nd premolar and 1st and 2nd molars, with some parts of the roots of the canine and 1st premolar teeth

Occusal or chewing surface of the upper 2nd premolar and 1st and 2nd molars of *Australopithecus transvaalensis,* Broom. The teeth have been slightly broken and the several portions pushed apart during the process of fossilization

When we examine the teeth, however, ve see that the fossil ape cannot be at ıll nearly allied to the chimpanzee or he gorilla. The premolars and 1st nolar are typically human in size and tructure, and they differ markedly rom those of any living apes. The anines, which are represented only by he sockets, are relatively small—larger han in man but smaller than in living ınthropoids. The incisors are also repreented only by the sockets. They are a ittle larger than in man, but appaıently not dissimilar. Then we have a starting human character revealed. In all ıpes there is a gap between the canine ınd the 2nd incisor, for the accommolation of the lower canine. In males of he chimpanzee and gorilla the gap is arge: in females it is small. In man he teeth form a continuous series, vith no gap. In this new fossil ape the condition is exactly as in man. The 2nd ınd 3rd molars are fairly like those of nan but considerably larger, also very nuch larger than the corresponding eeth in the chimpanzee.

The Sterkfontein ape is probably of ater date than the Taungs ape. The later may be Lower or Middle Pleistocene, vhile the former is most probably Upper Pleistocene. And, as the brain is somewhat differently shaped and the 1st nolars are also a little different, I have placed the new fossil form in a distinct species and called it *Australopithecus ransvaalensis* [to which science adds 'Broom," as per regular custom.—*Ed.*]

Besides the nearly complete skull we have a sacrum with part of the pelvis of probably the same individual as the skull, and I have secured much of the hind leg of what I believe to be a second skeleton of the same species, which was discovered in another cave some months ago. If these remains belong to *Australopithecus* then it must have been, like the chimpanzee and gorilla, relatively shortlegged, standing about four feet in height. It was probably much better able to walk on its hind limbs than any of the living large anthropoids. [The orang, chimpanzee, gorilla. The gibbon, fourth anthropoid, is not "large."—*Ed.*]

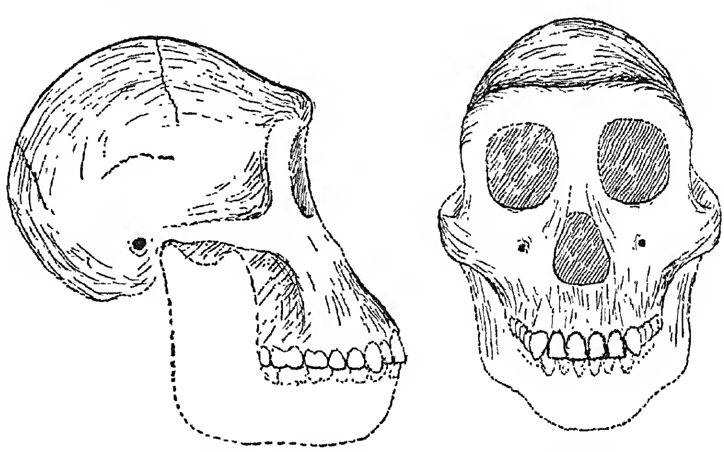
Exactly what the relationship of this ape to man may be will take some time to determine, as it will take weeks before a detailed study of the skull, pelvis, and limb bones can be completed. The fact that the Taungs child fossil skull has the milk teeth typically human in pattern, and that the Sterkfontein ape shows the adult teeth to be also strikingly human, seems to lead to the conclusion that these apes are much more nearly related to man than any of the living apes.

OSBORN has argued that man arose as early as Eocene times—perhaps 30,000,000 years ago, but with the exception of Wood-Jones no responsible scientist so far as I am aware holds this view. Keith thinks man may have arisen in Oligocene times—say 20,000,000 years ago. But few support such an antiquity for man and I know of no evidence in favor of the view. Gregory, McGregor, and Elliot Smith are all in favor of man having arisen in the Miocene epoch—say 10,000,000 years ago, and this is the opinion that finds most favor in the scientific world at present. There is certainly no undoubted evidence of human remains before Upper Pliocene—a little over 1,000,000 years ago, but man was already at this time so typically man that he must have originated some millions of years earlier. Still I do not see any reason for thinking that man is older than Middle or Lower Pliocene—arising perhaps 3,000,000 to 5,000,000 years ago.

The Taungs ape is probably not older than 500,000 or 750,000 years, and the Sterkfontein ape probably not older than 100,000 years, and they are thus too recent to have been man's ancestors. But we now know for certain that large anthropoids inhabited South Africa during Pleistocene times and that these apes, unlike the living anthropoids, lived on the plains and among the hills and sheltered in the caves. We are probably safe in assuming that somewhat similar non-forest living apes inhabited South Africa in Pliocene times, and it seems not at all unlikely that it was from some member of this group that the first man arose.

Monboddo in 1774 suggested that Africa would prove to be the ancestral home of man, and Darwin also held that it was much more likely that man arose in Africa than in Asia; and Elliot Smith, probably the greatest living anatomist, has for long held the same view.

The discoveries at Taungs and Sterkfontein of fossil anthropoids which are by far the most man-like of the apes seems strongly to support Darwin's views of Africa having been the "Garden of Eden."



Restoration of the skull of *Australopithecus transvaalensis,* Broom. About three eighths natural size. The mandible is unknown, most of the zygoma (cheek bone arch) is lost, and the upper nasal region is unknown, but otherwise the skull is nearly complete. As, however, there is no contact between the face and the cranium the exact relations of the face are not quite certain, but the position of the face must be nearly as here restored. Possibly the lower part of the face and the mandible ought to be a little narrower

# HIGHWAYS UP-TO-DATE

## Greatest Need is for "Freeways" . . . What is Being Done in Foreign Countries . . . The Inter-American Highway . . . Much Work Remains

By ALFRED H. SWAYNE
First Vice President and Chairman, Highways Committee, Automobile Manufacturers Association

HIGHWAY development in the United States has followed a rather checkered career, starting with the trails of the Indian and leading up to the traffic arteries of the present day. With the advent of the white man as a permanent resident of this country, came a desire and need for communication between settlements; hence the stage-coach or post-roads. For a time canals or water highways claimed a large measure of attention; then came the railroad. With the tremendous developments of railway rights-of-way, little attention was given to the roads which were then used largely for local individual transportation by foot and by horse, and the result was the deterioration of those few roads which had already been built. Soon came the bicycle with its demand for relatively smooth surfaces, and a background was developed for the highway system of today.

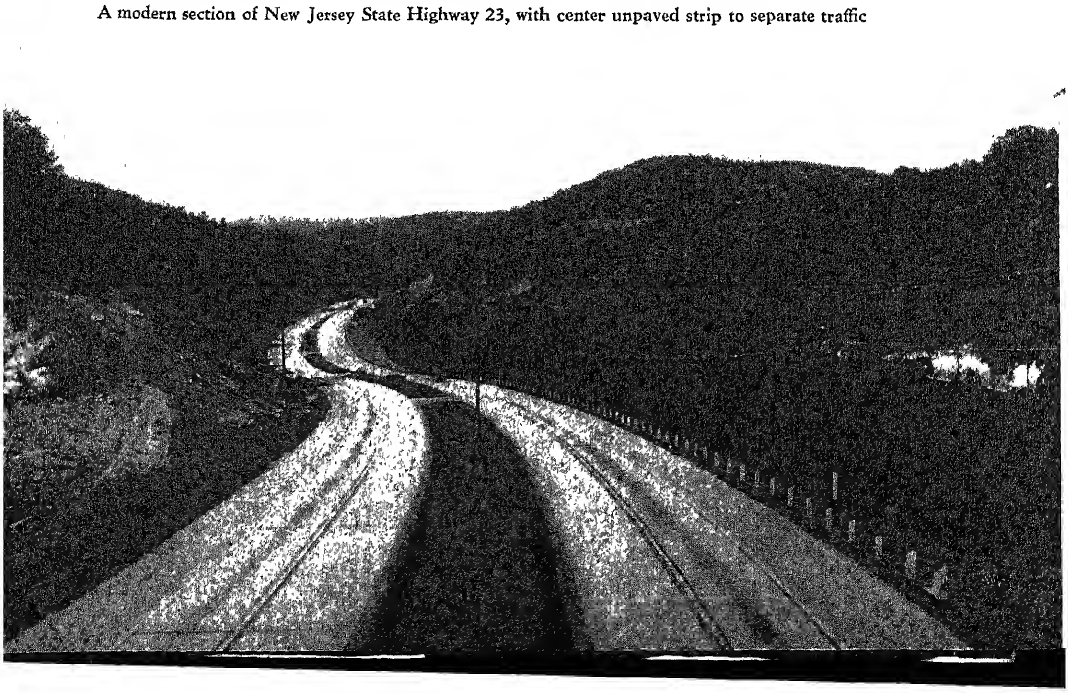
At the turn of the century a new factor entered the field of transportation and completely changed the complexion of the entire situation. The motor-driven vehicle created, almost over night, a demand for comparatively broad highways that would be usable in all kinds of weather and would withstand the wear and tear of constantly increasing traffic.

Faced with these new problems, engineers took up the study, and sporadic road-building for motor vehicles started in various parts of the country. But as knowledge of the technical requirements of road-building advanced, the motor vehicle advanced in numbers in a ratio that constantly out-distanced the efforts of the highway engineer.

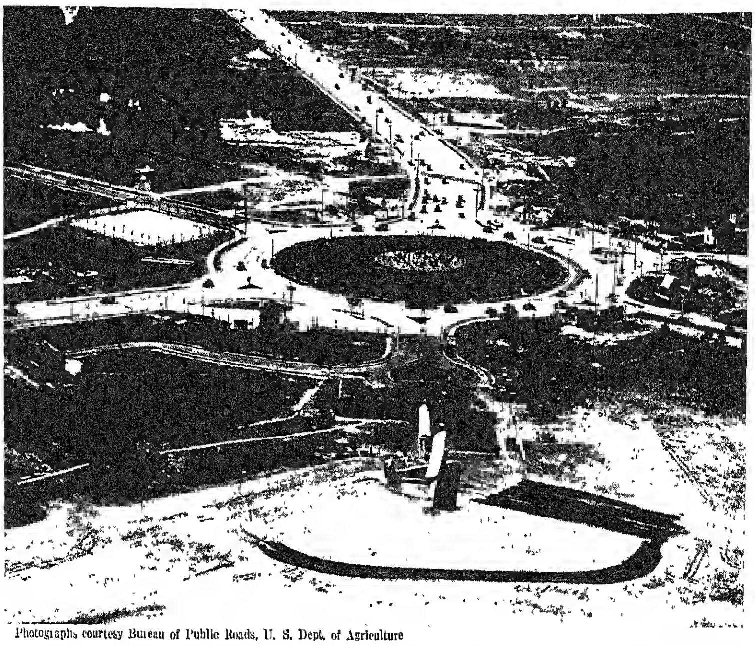
WITH the establishment of the Bureau of Public Roads in 1916 and the co-ordination of efforts and financial requirements toward improved highway systems, road-building spurted ahead. However, because of the permanence of roads after construction as contrasted to the relative impermanence of motor vehicle units, traffic outgrew the roads almost as rapidly as they were built. Motor vehicle accidents increased as congestion became intolerable in certain localities, cost of road construction grew beyond desirable limits, and it became obvious that a thorough analysis must be made of the entire situation as a whole if satisfactory results were to be achieved. Highway objectives are, in general, as follows: to facilitate the fullest possible movement of a maximum volume of traffic, with maximum safety, at a maximum degree of economy.

Obstacles to the attainment of these objectives are the difficulties of condemnation of land for road building and lack of funds to meet immediately *all* of the widespread demands for building and maintaining highways regardless of their relative value to the number of vehicles which may use them. If these obstacles can be overcome, and I believe that they will be, highway engineers can construct roads that will meet all the requirements and continue to meet them as traffic increases. One of the greatest highway needs in the United States is for "freeways" or "limited

A modern section of New Jersey State Highway 23, with center unpaved strip to separate traffic



ways" in concentrated population centers. These freeways, as proposed by the Regional Plan Association, call for a strip of public land devoted to the movement of traffic and over which the abutting owner has no right of light, air or direct access. Essentially they will be well-designed express highways but lacking the multitude of "hot dog" stands, billboards, and gasoline stations, which so frequently decrease the efficiency of a road and introduce danger points on curves and hills. Some of the plans and methods of design that are commonly used on modern highways will be used in freeway design, such as traffic flow alinement with a central unpaved strip to separate vehicles moving in opposite directions, banking of curves, and various methods of handling intersecting traffic. One of the greatest advantages of the freeway will be its "express" characteristics and it will undoubtedly reach its first use in connecting congested traffic areas with vacation lands in the mountains and at the seashore. Thus, for example, a freeway from Washington to Boston would provide a safe high-speed transportation medium for motor vehicles which, by using it, could avoid all cities and towns and still could have access to the freeway at many points not too widely separated. Such a freeway would open to motor vehicles all of the vacation lands of the eastern United States and would provide, as mentioned above, free movement of a maximum volume of traffic with maximum safety.



Photographs courtesy Bureau of Public Roads, U. S. Dept. of Agriculture

A traffic circle relieves congestion at an intersection near Central Airport, Camden, New Jerse

ANOTHER large and significant factor in highway design is the separation of traffic within and near large cities. This point involves not only motor vehicles but also pedestrians, who constitute a large proportion of motor vehicle fatalities. By the construction of grade separations of various types and the provision of sidewalks for pedestrians with over- and underpasses, many of the problems can and will be solved.

In the meantime, there is much that is being done to develop existing highways with the funds that are available. Curves can be properly banked and made more sweeping, perspective for the driver can be increased so that approaching danger can always be seen and thus avoided, and highways can be made wider to accommodate a greater volume of traffic.

In order to see clearly what can be done in the matter of highway construction, it is advantageous to survey work being done in other countries, which work, incidentally, is based largely on American research and engineering practices. No other nation has gone so far in sub-soil research, in perfection of construction, or in maintenance, to mention but a few of the many important phases of road construction, as has our own under the leadership of Thomas H. MacDonald, director of the United States Bureau of Public Roads.

In what has been done in Europe and in what is happening there are both significant differences and significant analogies with the progress which has been made in the United States. The differences of course are very deep. The countries of Europe have a mixed traffic, the like of which is not found anywhere in our country. In some places, millions of cyclists crowd the road and are met all over the highway by the impatient motorist. In some lands the farmer lives in the village or town and goes to work on his farm each morning as he has done throughout the centuries since the time when his personal safety at night required that he and his stock should find a common resting place with his neighbors in self-defense. So herds of cattle, pedestrians and flocks of indolent geese throng the highways as night comes on.

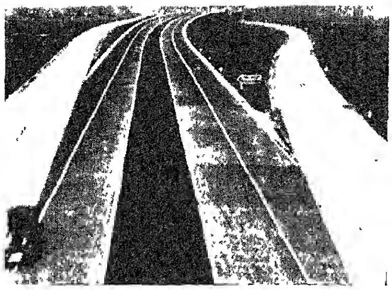
Horses and even oxen are found plodding their way with heavy loads. Pigs and chickens have not yet learned that the roadway is unsafe. The road is a cross section of communal life on which the peasant performs part of his daily labor, or on holidays and Sundays moves en masse along the road, gossiping with his neighbors, marching in festal, singing array, searching his way to quiet, restful spots for a family picnic or day in the open.

Behind the basic differences in standards and ways of living presented by these conditions, so different from those of the United States, there are other equally fundamental differences in government to be considered. The man who controls the destinies of a people can sit at his desk as Napoleon did and draw the lines for his roads with pencil and ruler. Expropriation of needed lands follows as a matter of course. Funds can be concentrated, specifications drawn, construction undertaken in a way and on a scale which a democracy only reaches through painful stages.

THERE is neither the long drawn out court procedure to oust the unwilling proprietor from strips of land which are necessary to the public welfare, nor is there the excessive cost which frequently results from appraisals made by local officials when land is finally condemned in this country. Nor is there the immediate necessity for consideration of a public opinion which insists that each locality, sometimes even each resident, shall secure his part of the public appropriation for his road regardless of the larger interest.

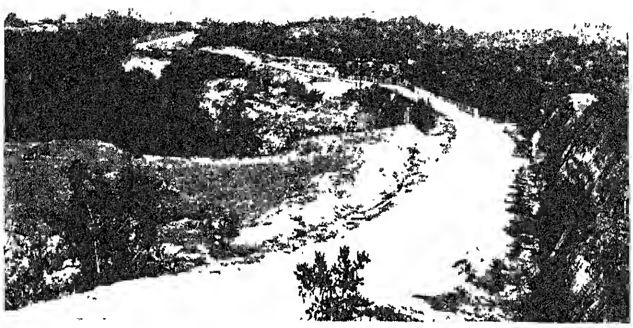
In Germany, for example, there is now under way a program for the construction of 5000 miles of completely separated highways — *autobahnen* — each having two lanes of traffic moving in either direction with a parkway between them. Bridges or underpasses take care of cross traffic of both motor vehicles and pedestrians. Take-off roads of varying designs, usually from 10 to 15 kilometers apart, permit traffic to enter or leave the main road. At the time of writing, approximately 1000 miles of this program is complete, the surfacing of another 1000 miles is under way, and about 1000 miles are in the blueprint stage or under preliminary construction.

Overshadowing the amazing undertaking of Germany, largely because of



Highway separation as achieved on an *autobahn* in Germany. Note the underpass in background. Eventually there will be 5000 miles of these roads

*Below:* A section of the Central Highway of Panama which is included in the route of the Inter-American Highway



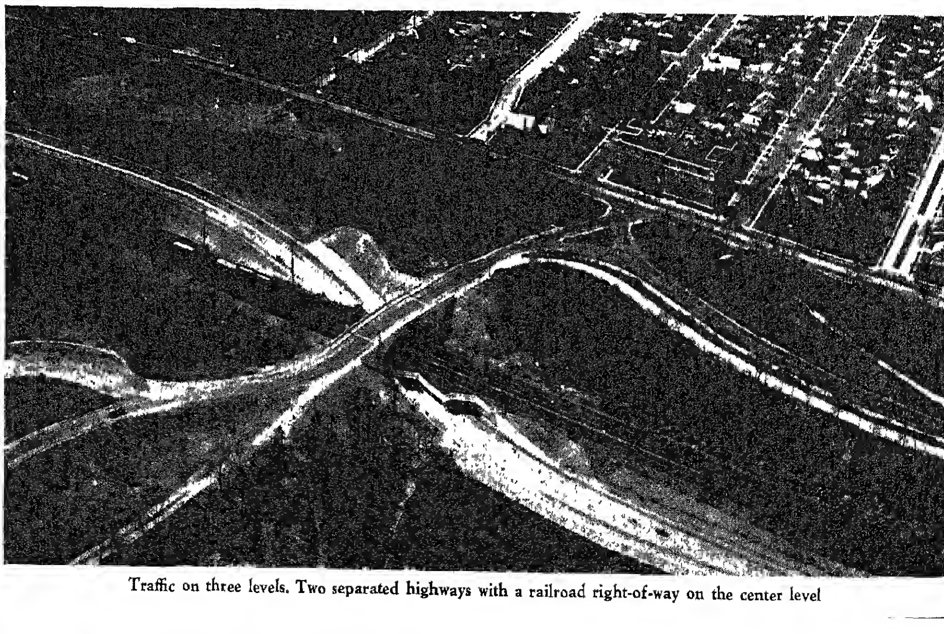
the international scope of the program, is a highway which eventually will connect London, England, with Calcutta, India, and Capetown, South Africa. Parts of this route are already in service and other parts are well under construction. Of similar importance and just as romantic in conception is the Inter-American Highway, which will run from Nuevo Laredo, Mexico, to Panama City, through Mexico, Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica, and Panama.

Work now being done in Paris, France, represents one of the most fascinating projects in highway construction in progress anywhere in the world, and gives a key to the solution of traffic problems in congested areas. The ring of fortifications which surrounded ancient Paris has been converted into a circular belt highway. Farther out from the city, French engineers are now constructing a second belt with others projected still farther out as traffic developments may require them. At intervals on these belts, highways converge in the form of squares or circles.

With these brief glimpses of what has been done, is being accomplished, and will soon be consummated, it becomes apparent that the highway engineer has a complete grasp of the situation. He is able to provide safe, fast highways adequate to take care of traffic conditions for some time to come after completion, and will do this just as rapidly as funds and legislation permit. An excellent summation of the entire highway situation as it exists in the United States today is given by Mr. MacDonald, in the Annual Report of the Bureau of Public Roads, as follows:

"IN the immediate future a large amount of work should be done in making more adequate for traffic that already exists those highways deliberately improved under a policy of stage construction to a degree known to be less than that ultimately desirable. There is also a need for the further extension of improvements to the more useful secondary and land-service roads, many of which still await improvement. Needed improvements on the main highways include considerable improvement of alinement, reduction of grades, and elimination of railroad grade crossings and separation of grades at intersections.

"Although much work of the kind described is necessary, there is no reason whatever to assume that the main highway system, as a whole, is substantially inadequate. The need for further improvement exists principally on a limited mileage of heavily traveled highways, especially near large cities in industrial sections and on those roads which, because of their early importance, were the first to be improved and were therefore constructed according to lower standards than have since prevailed. Viewing the work of past years as a whole, the system of highways created is remarkably adequate."



Traffic on three levels. Two separated highways with a railroad right-of-way on the center level

# Twelve Years of MOTOR COACHES

## Early Systems "Just Grew" . . . Co-ordination Resulted in Progress . . . Comfort and Convenience for Passengers . . . What of the Next Five Years?

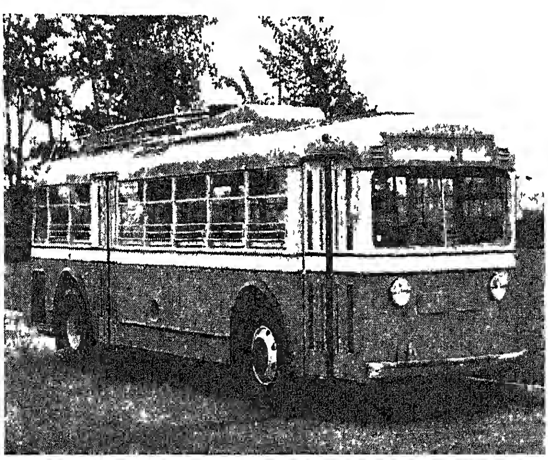
By I. B. BABCOCK
President, General Motors Truck and Coach

TWELVE years in history is a brief period. Yet reckoned by events rather than by mere calendar years, the past 12 have provided an epoch unparalleled for progress in our transportation system.

During this period the motor coach, once classed as a "fad," became an integral part of our economic and social structure, taking its place in our scheme of transportation alongside of electric railways backed by 50 years of experience and the steam railroads with more than a century of history behind them.

In the early days of motor coaches, they were a mixture of cumbersome truck chassis and improvised bodies, many of them simply being planks placed across the truck frames. Motor coach systems were like "Topsy" of Uncle Tom's Cabin fame; they "just grew."

Although there are records of motor buses having been operated as early as 1904, it was not until the outbreak of the World War that the economic need for motor buses began to be realized. Almost overnight, streets of cities throughout the country became crowded with "jitneys" which created great traffic hazards and, while providing a more rapid means of transportation, could not either give adequate service or protect those who rode.



One of the "all-service" coaches pioneered by Public Service Coordinated Transport of New Jersey. These vehicles are equipped with both gasoline and electric motors and can be run either on a double-wire trolley system or under gasoline engine power on any highway, making for flexible service

In the early 1920's there were but few cities in which motor coaches were being operated, and a 35-mile operation in inter-city work was regarded as a long haul. But as manufacturers developed more dependable vehicles, with better paving in the cities and concrete highways extending to all parts of the country, the use of motor coaches grew by leaps and bounds, each year increasing in popularity and building transportation by motor coach into one of the major businesses of the country. All this occurred in a period of but 12 years.

A glance at the history of motor-coach transportation is interesting and of importance in that it reveals how quickly the American public will accept that which is new when it is better. When Grover Cleveland was elected president in 1884, local transportation, except for a few cable lines, was dependent entirely on animal power. In 1888 came the first successful application of electricity as a power for transportation vehicles, when a system was established at Montgomery, Alabama. Within the next 10 years city after city joined this electrification trend, completely replacing animal power. The street railway had become the electric railway.

Then came the great development—the invention of the internal combustion engine, which made private transportation over streets and highways available to nearly every family in America. This opened new marts of trade, carried people from the congested districts of cities out into new residential territories away from established electric and steam railway lines—resulting in the evolution of a new transportation vehicle, the motor coach. People were not to be content with improvised buses; they demanded better transportation, and from this demand evolved coaches which provided a safe, comfortable ride, capable of rendering a flexible type of transportation quite different from anything previously possible.

The year 1924 saw the motor coach actually take its proper place in the transportation system. In that year large and small electric railway properties began to use motor coaches and steam railroads started toward a co-ordinated system of rail and buses. Revolutionary results followed the adoption of motor buses in local transportation and the electric railway industry became the transit industry.

WHEN the industry was carrying two billion passengers a year back in the 80's, it was regarded as big business. There was talk then that the opportunities for further progress had been exhausted and that the era of expansion was about over. Today the transit industry is carrying over 12 billion passengers a year, with a gross revenue in excess of one billion dollars. This is a greater volume of business than the steel industry did in 1931. It almost equals the combined revenue from telephone and telegraph service. The industry has the largest number of customers for a single product of any business in the world.

Yet the motor-coach business, despite the sensational progress it has made in the past few years, is still steadily growing. We are now well into another era in motor-coach transportation—an era of modernization. There are in existence in the United States at the present time 22,000 street cars known to be 20 or more years old. In addition there are another 15,000 street cars known to be

Transportation *sans* comfort: A motor bus of the vintage of 1911

from 15 to 20 years old. In addition to this rolling stock there are more than 10,000 buses in city service approximately five or more years old.

Thus the transit industry alone faces the prospect during the coming five years of having on its hands 47,000 pieces of equipment that have passed the age limit of economic usefulness. Estimating conservatively, it is reasonable to predict that at least 50 percent of this obsolete equipment will be replaced with new rolling stock at an expenditure of 235,000,000 dollars—approximately 50,000,000 dollars per year.

How swiftly the public has accepted motor coaches for transportation is shown in the record of achievement. In 1922, only 18 cities depended exclusively upon motor coaches for transportation, while 560 cities depended exclusively upon rail service. Another 197 cities were supplementing their rail service with coaches.

By 1932—10 years later, 300 cities had gone "all bus"—a third of the cities in the United States—and 447 additional cities were enjoying the advantages of co-ordinated transportation—rail and bus. Today, 419 cities depend exclusively on motor buses for their public transportation. From 1925 to 1935 the transit industry increased the number of buses operated by it from 1200 vehicles to 18,200 vehicles. During the past five years 75 percent of the equipment bought by city operators has been gasoline buses.

There are several causes for this rapid substitution of motor coaches in city transportation service: 1. The difficulty of amortizing original investments. 2. The relatively low capital investment required to operate bus service. 3. The desire of the public for quicker, more convenient, and low-cost service.

WHEN business skies started to brighten early in 1935, many city operators took advantage of the upturn in riding and started programs to rehabilitate, and in many instances, completely modernize their properties. These modernization programs resulted in the biggest coach-buying year of all time. However, the record lasted but a short time, 1936 setting another new all-time high in the purchase and delivery of coaches.

Among the many important and interesting highlights of these modernization plans was the substitution of coaches by The New York City Omnibus Corporation, on the street railway lines of New York Railways. This substitution required 768 coaches. This gigantic venture was an immediate success. Riding increased sensationally, revenues shot upward.

Public Service Coordinated Transport of New Jersey, the largest city operator of motor coaches in the country, embarked on a 6,800,000-dollar program of modernization. Among the 377 coaches purchased by this company were 27 Diesel-electrics, the first coach fleet in the United States to utilize Diesel power and the first in the world to use Diesel-electrics.

Chicago Motor Coach and Fifth Avenue Coach Company placed in operation nearly 200 double-deck


An ultra-modern coach, seating 72 passengers, with the engine mounted in the rear, and, *above*, a view of the upper deck showing the seating arrangement

coaches, seating 72 passengers and embodying every modern feature for passenger comfort. St. Louis, Boston, Kansas City, Houston, Dallas, New Orleans, Memphis, and hundreds of other cities have been active in improving their properties. In the inter-city transportation field Greyhound placed the largest single coach order of all time, purchasing 505 modern highway cruisers to augment a fleet of 325 such coaches placed in service during the year. The National Trailways System, composed of five of the leading inter-city operators, organized to give coast to coast service —hundreds of other inter-city operators placed new equipment on their lines.

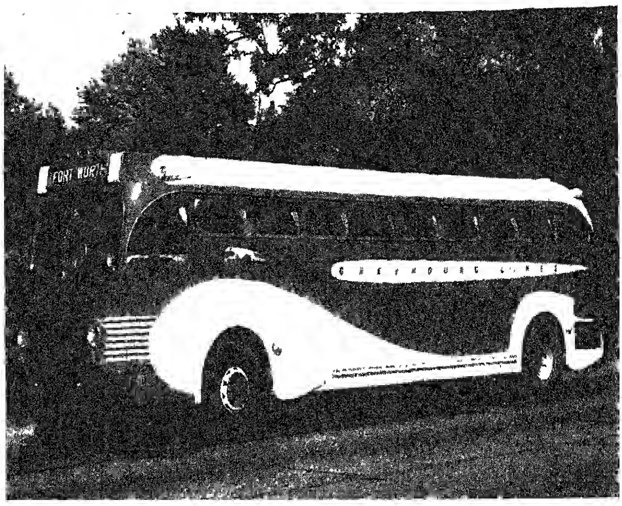
In nearly all modern motor coaches the engine, heretofore located at the front end of the coach under a hood, has been mounted in the rear of the coach, providing an entirely unobstructed interior for passenger use, and leaving fumes and engine noise behind.

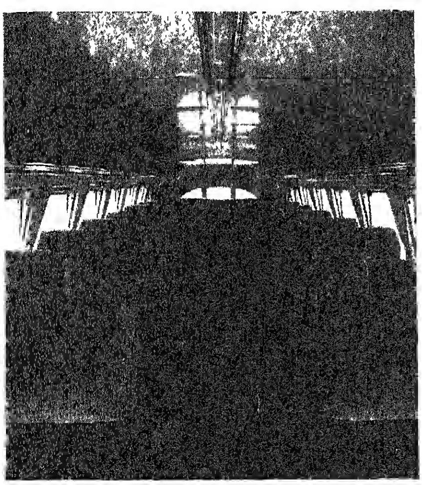
Seats have been modernized to give the utmost in comfort; new lighting systems and color schemes give restful interiors; newly developed ventilation systems provide fresh air throughout the coaches at all times, without draft.

Through the use of rear engine mounting, modern coaches have perfect weight distribution with ⅓ of the weight on front single tires and ⅔ of the weight on rear dual tires. Not only does this result in smooth, comfortable riding qualities but it is a great safety factor. Safety is further enhanced by the use of all-metal bodies.

What has been the effect of this rapid trend to motorization in transportation? The public has been given a fast, convenient, and low-cost service, being able to board the coaches near their homes and to alight near their destinations; the operator has been able to build strong, efficient, and profitable transportation lines; the coach manufacturer has become a leading figure in our transportation picture.

In speculating on what the future holds for city and inter-city motor-coach transportation, there is every indication that it will continue to move forward rapidly to give to the riding public the benefits of years of successful operation.





**Greyhound recently ordered 505 of these coaches after operating 325 of them. This is the largest coach order of all time. *Left:* Interior of one of these new highway cruisers, seating 36 passengers**


***Below:* One of the most popular city coaches of all time, seating 32 passengers and with rear engine. Nearly 1000 of these have been placed in service. *Right:* An interior view**

# THE HEALING MAGGOT

## One Superstition that Turned out to be a Fact . . . Science Went to Work, Maggots Went Out, Allantoin Came in, Followed by Urea . . . Now We Understand

By T. SWANN HARDING

FOLKLORE has made many contributions to the science of medicine. Many remedies now esteemed by the very best doctors were at one time derided as superstitious. Withering, in 1776, learned that foxglove was used by old women to cure dropsy, which was then regarded as a disease; he tried it in his practice and became convinced of its value. It was very much later that digitalis was purified from this plant and adopted as such by pharmacy.

This sort of thing had happened over and over again, quinine from Peruvian bark being another example. In some cases, of course, the empirical remedy—vipers, salamanders, cockroaches, lice, or whatnot—seemed merely to have the limited, negative virtue of being unpleasant even to think about. More often than not the folklore remedy was really worthless, though the possibility that such old wives' cures may be of value should always be considered.

Nothing could be more revolting, for example, than a maggot-infested wound; nothing could be more grotesque than the treatment of wounds with the excrementory product of insect larvae; nothing could be more fantastic, or has been more derided, than the external use of urine for medicinal purposes. Yet just these substances and processes have recently found their way into scientific medicine and have assumed considerable importance.

In the apocryphal book called Maccabees we are told about the terrible death of the Greek ruler Antiochus, an early persecutor of the Jews. His maggot-infested wounds are held up to our horror. Yet, centuries later, the so-called "father of French surgery," Ambroise Paré (1517-1590), observed the frequent presence of fly larvae in wounds, and appears to have had some idea that their effect was beneficial.

INDEED, there is nothing new under the sun, for the so-called maggot treatment of bone injuries, in which larvae of blowflies were placed in wounds to clear up decayed tissue and hasten healing, is not new. It was known to the French surgeon, Baron D. J. Larrey, in the time of Napoleon. While the Syrian wounded were usually terrified by the appearance of blue-fly larvae in their wounds, the Baron said: "Nothing short of experience could convince them that these insects, so far from being injurious to their wounds, promoted rather their cicatrization, by cutting short the process of nature and by causing the separation of the cellular eschars which they devoured. These larvae are, indeed, greedy for putrefying substances alone, and never touch the parts which are endowed with life."

These were some of the clean, pampered and socially select, sterile maggots, as formerly applied

The modern use of maggots to clear up wounds, especially those of the bones, dates from field observations made during the World War. The well-known Cleveland surgeon, Dr. George W. Crile, called attention in 1917 to the more rapid healing of wounds containing maggots. But it was the late Dr. W. S. Baer of Johns Hopkins who made the first extensive clinical tests, developed a technique of using the maggots, and vigorously advocated its general adoption.

Many cases of stubborn, deep-seated bone infections came to Dr. Baer's attention "over there." In one instance two seriously wounded soldiers had lain on the battlefield about a week before they received attention. Their wounds had become infested with maggots of the common blowfly, making them horrible to behold. Yet these serious and infested wounds, when cleansed by the physicians, healed with marked rapidity.

Despite their long exposure these men made a rapid recovery, in marked contrast to the high death rate of others from similar wounds. Some years later, when treating cases of the chronic bone disease called osteomyelitis, in Baltimore, Dr. Baer remembered this battlefield experience. As a last resort he tried the blowfly maggots on two young girls who suffered from this dreadful disease. They worked like magic!

THEREAFTER maggot treatment for osteomyelitis spread rapidly throughout the United States, as it is said all really good, sound remedies do spread. However, it seemed possible that the maggots might at times carry dangerous infective germs and the problem arose of raising sterile maggots wholesale. Appeal was made to Dr. William Robinson of the Bureau of Entomology and Plant Quarantine in Washington.

Dr. Robinson and his associates solved the problem of mass production of sterile maggots. They made the maggot treatment safe, but it was still revolting. Patients disliked it. Doctors disliked to submit them to the treatment. The question arose: What do the maggots do or produce that enables them to cure wounds? Just as pure digitalis had been prepared from foxglove, so now some curative principle must be prepared in pure form from maggots—and exactly that took place. In 1935 Dr. Robinson was able to announce that blowfly maggots cured wounds because they pro-

duced "allantoin" as an excrementory product. This colorless, odorless chemical compound, which, it was discovered, had been used 23 years earlier in the treatment of non-healing ulcers by Dr. C. J. Macalister, and not the maggots *per se*, effected the cure. Allantoin is harmless, painless, and inexpensive, a moderate-size application costing but five cents and being in no way revolting.

It promotes the healing process in the wound from the bottom up. It is present also in the embryos of certain animals, mixtures of which have a healing effect on wounds. Maggots therefore healed the wounds involuntarily and merely because they happened to excrete allantoin. General granulation of the tissue with rapid healing could be produced by packing wounds with allantoin-saturated cotton. Non-healing wounds, burns, and ulcers yielded to its magic.

EXPERIMENTATION started in a Washington hospital but soon doctors all over the country were using the new method. Weak solutions of allantoin were effective; the excretions placed in wounds by the live maggots were very weak in strength indeed. Case after case showed improvement. Stomach ulcers, bladder inflammation, and other internal irritations began to be treated. (Self-medication is not advisable, however, so consult your physician always.)

As explained at the convention of the American Medical Association in 1936 by Dr. S. W. Simmons, also of the Bureau of Entomology and Plant Quarantine, certain body cells become dormant and seem unable to grow or to reproduce themselves when wounds occur. But contact with allantoin gives them power both to grow and to multiply. However, allantoin does not cause the excessive and abnormal type of growth characteristic of cancer.

Science on the trail of knowledge. Extracting allantoin from maggots

Exactly what happens in the living cell is still a mystery and until this is solved medicine must always be much impeded. But the factor that enables dormant cells to grow and heal wounds may, if lacking, apparently be replaced with allantoin. This penetrates the cell and causes its nucleus to regain its lost power of activity. When allantoin is applied, healing takes place in bone, muscle, and skin.

Chemically speaking, allantoin is a derivative of urea, a waste product of the body excreted in the urine. In August 1936 it was not surprising, therefore, that Dr. Robinson announced in the *American Journal of Surgery* the fact that a 2 percent solution of the chemical urea, made with sterile water, would itself produce healing if applied to stubborn wounds.

Urea can be made by combining ammonia with carbon dioxide. It is made from the gases of the air on large scale, for it is widely used as fertilizer. It also occurs in human tissues and in many plants, though it derives its name from the fact that it was first discovered in urine.

UREA has great historical significance because it was the first chemical having its origin in living organisms which was made synthetically in the laboratory. In 1828 the German chemist Wöhler announced that he had succeeded in producing urea without the aid of a kidney. He had made it by heating ammonium cyanate. Until then it had been supposed that socalled "organic" chemicals, other than carbon dioxide and water, could not be made artificially. The average person excretes a little over an ounce of urea daily.

In his latest work Dr. Robinson cites many case histories provided by physicians, surgeons, and dentists. They have used weak solutions of urea in treating osteomyelitis, gangrene, old ulcers, stubborn wounds, infected burns, and non-healing gums and tooth sockets. The reports are encouraging. Many of them are sensational. If this good work is borne out by additional clinical tests carried out under close control, the discovery will be one of major importance.

Medicine must make haste slowly, as always. It must not jump to conclusions, even though no ill effects have yet been recorded. It is an odd coincidence and a significant one that human urine is roughly a 2 percent solution of urea. Consequently there may have been sound reason for its medicinal use as an application to wounds. Fortunately urea itself is an entirely inoffensive substance. It is present in the tissues and blood of animals and of human beings. It occurs in many plants used for food, notably in spinach. It is an almost snowlike, crystalline chemical. Under the microscope a pinch of it looks like a miniature log jam of sparkling sticks of ice. It is made commercially by the ton by combining three gases that occur in air and in water—nitrogen, hydrogen, and carbon dioxide.

Dr. William Robinson, who solved the problem of mass production of sterile and socially eligible maggots. They almost became pets

Treatment with allantoin was inexpensive but with urea it is still cheaper. Pure urea, long used by doctors as a diuretic, sells for a small fraction of the price of allantoin.

But why did it occur to the scientists that urea might be as valuable as allantoin? This was not because it was associated with allantoin in the maggot excretions so much as because the picture or structural formula of allantoin, as written out by organic chemists, showed how easily a "side chain" of allantoin might be chipped off so as to leave urea.

THE formula of allantoin is written by organic chemists in the form of a square with an NH and a CO group at the bottom corners and an NH and a CH group at the top, left to right, the letters standing for nitrogen, hydrogen, carbon, and oxygen. But, attached to that CH at the top right of the square the chemist put this: CH—NH—CO—$NH_2$, and all of that which is written after the CH is nothing but urea. Hence he reasoned that the NH—CO—$NH_2$, or urea, was probably chipped off from the allantoin in the wounds, and just that proved to be the case.

There you have the story to date. Man first used blowfly larvae and then one of their excretions to heal wounds. Finally he came to see that the white crystalline chemical urea, which occurs as a human excretory product, was the real healing agent.

# After Cars Come Trailers

**Mobile Homes for Everybody . . . What They Offer . . . Designs . . . Construction . . . Booming Trailer Industry . . . How Long Will it Boom?**

By PHILIP H. SMITH

EIGHT years ago there were a mere dozen manufacturers of tourist trailers and their combined output numbered in the hundreds; in 1935 the number of producers had swelled to 300 and they turned out about 25,000 trailers. This year, over 700 manufacturers will produce something like 80,000 homes on wheels.

These 700 manufacturers, large and small, comprise the heart of this soaring, incalculable industry which seems to have taken these United States by storm. Fringed around it are concerns which do nothing but supply parts such as wheels, axles, springs, frames, windows, and hitches, while less closely associated are established manufacturers working overtime to furnish such materials as plywoods, veneers, composition boards, and good solid wood.

Yes, we've got a brand new industry. One that rose like the Phoenix out of the depression and appeals to the public as nothing else has since the advent of the automobile. With the lure of home, sport, and travel all rolled into one, few of us escape being smitten and that makes for talk however strong or weak our desire for ownership.

Maybe you thought the output of tourist trailers was larger than it is. Well, commentators have been prone to double every figure, thinking, no doubt, that fancy would become honest fact before the comments got into print. But the truth is striking enough because rarely has an industry grown with more rapidity. If it had grown any faster it couldn't have had its present substance.

Despite expansion, trailer manufacture is still an infant industry, likely to develop into almost any kind of a child. In its origin, way of going about it, public response, and character of growth, it parallels most closely the development of the automobile industry. Whereas the automobile issued from carriage builders and machine shops, the trailer comes largely from commercial body builders, carpenter shops, and garages. Only within the past year has large scale production been undertaken by companies organized purely for trailer manufacture. The bulk of the 700 companies still think of output in terms of single units—to make of it a handicraft proposition.

THE earliest products were designed primarily for camping. They were frequently of the expansible type and scantily fitted in true camping style. Today's product simulates a fully-equipped, modern apartment in which the routine of year-'round living can be carried on. Take off the wheels of the trailer and you have a house in miniature, designed for all climates and capable of being used indefinitely far from civilization. The present-day trailer is a hybrid, taking a little something from everybody. The building industry gives it materials; body builders contribute the art of joining woods; airplane design furnishes ideas for strength with light weight; the automobile industry supplies its knowledge of metals.

Trailer design, although still in the formative stage, has approached a high degree of standardization in form and character of fittings and arrangements. All trailers carry housekeeping devices such as an ice box, stove, sink, water supply. They all are equipped with dual electrical systems: a 6-volt circuit to operate from a battery and a 110-volt system for outside plug-in connection when parked near current. They have countless cabinets and drawers and, of course, accommodations for sleeping.

Strange to say there is yet no close correlation between price and quality in the sense of strength and durability. The correlation between price and size is definite. There are some low priced trailers that are better made than some higher priced ones, the reason being largely that the chassis and shell (sans fittings) can be produced well for a small figure, while the fittings can run into much money depending on the cabinet work and woods used. Appearance,

**Essentially for vacation tourists, this trailer uses a combination of metal and fabric in its structure for light weight**

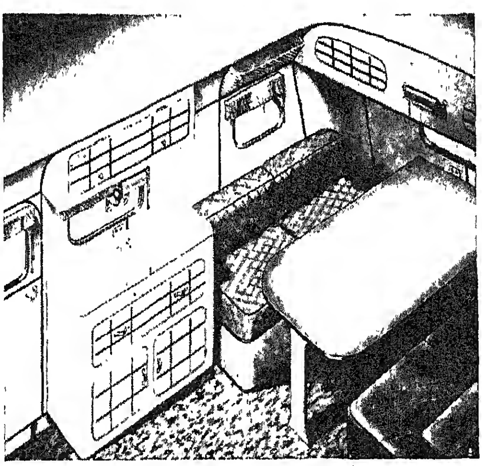
**A year-'round home on wheels with heat- and sound-insulated panels of aluminum riveted to a metal frame**

therefore, is not a reliable indicator of road life.

To obtain maximum comfort in a trailer you must pay 1000 dollars or more for it; but you can be well satisfied for much less. The newest luxury models will boast heating plants, hot and cold water, baths, self-contained electric light plants, and ventilating systems elaborate enough to be termed air conditioning. They will also feature brakes and toilet facilities as standard equipment.

AT the moment there is great controversy within the industry as to what constitutes the best type of construction. All agree that a steel chassis is essential for safety and long life, but there is no agreement as to the best material for the exterior wall panels. Some say metal; others say anything but metal. Among the former are those who believe that the trailer is a sort of offshoot of the automobile; among the latter are producers who think of the trailer more in terms of a house. A third minority group declares that the ultimate material has yet to be developed.

As an outcome of the divergent opinion there is great variety in wall construction. We find plywood, plywood covered with leatherette, hard composition board, soft composition board, thin sheets of galvanized steel backed with plywood, steel backed with a sound deadening and insulating material, and aluminum sheets. Proponents of metal claim greater safety and more durable construction; opponents declare metal unnecessary for strength, excessively hot unless well insulated, and unduly heavy. The final outcome will be determined by the public and its demands.



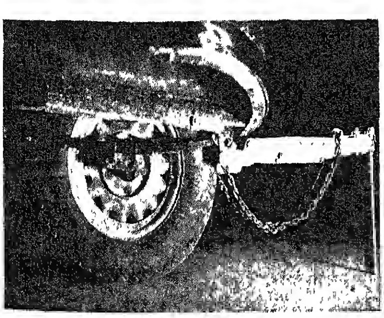
All-metal fixtures are a feature here. The dinette arrangement can be altered to form a very comfortable double bed

Brought to its present state of perfection, what is the future of the product and of the industry that makes it? Will the trailer of five years hence be the trailer of today save for minor modifications? Will the industry continue to expand without apparent limits to create a mobile population? What are the trends? These are questions that are puzzling producers, interesting the public, and intriguing the man who wants nothing better than to get in on the ground floor of a "natural."

Character of product and growth of the industry are very closely linked. Ultimate use will be the deciding factor. Will the trailer become primarily a week-end and vacation vehicle or the substitute for a home?

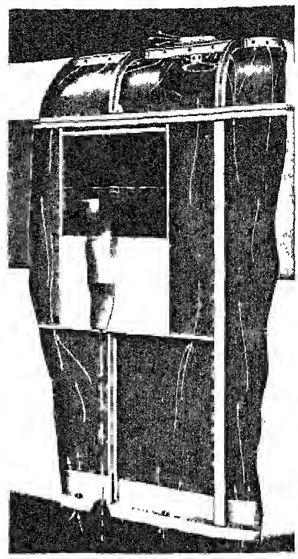
Trailers are being used for pretty nearly everything and by all classes of our population. They have been purchased for vacation travel, for hunting, for homes, and for commercial use. Itinerant workers have taken to them, pensioners and retired citizens have pulled up stakes and departed in them. Salesmen are using trailers to drag their wares around the country.

Of the many current uses, the commercial is the easiest to plot. It has been slowest to get underway, but destined to grow rapidly. Concerns manufacturing refrigerators, stoves, lawnmowers, glassware, and a hundred other items have found the trailer a boon for the demonstration and display of their wares on a national scale. More and more companies are taking to it, and trailer fleets are beginning to multiply to insure a back-log of trailer sales.



A swiveling third wheel at the nose of this trailer takes the weight off the draw-bar and hitch

The ultimate use of trailers by the public is not so easily forecast. Even trailer producers are at a loss to foresee where the flare-up of interest may lead. It may be significant that the majority of producers are skeptical of the idea that the bulk of our citizens will live on wheels. Most of them have a long-term,

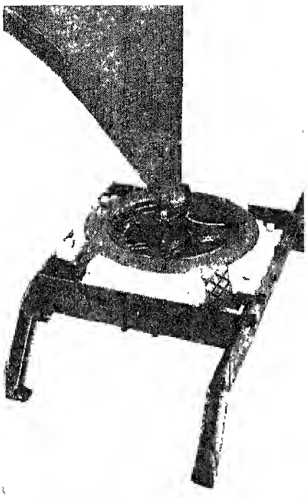


A blower draws air through the double walls, cooling the interior

first-hand experience in trailer living, but we must not forget that there were automobile manufacturers who became nervous when 5,000,000 automobiles got into owners' hands and who planned to retire before the "fad" blew over.

What people now see in the trailer is chiefly a means for getting around the country with maximum choice of how, when, and where, and at a minimum cost, once first cost is absorbed. The appeal is tied securely to sport, leisure, day-dreaming, and economics—above all, economics. The urge, the necessity, to live without paying taxes and rent is behind the sudden expansion of this industry. Without the promise of providing a home at a fraction of the cost of a house, the trailer industry would never have become the most talked about business in this country. Will home owning continue to be the major stimulus? Let's weigh it.

If you will query trailer manufacturers as to where their market lies, you will find a fairly even division between those who believe intermittent vacation use will keep the factory wheels turning and those who believe that year-'round homes are what people want. This split, in itself, heralds a diversity of product to suit both markets. Believing that vacation use does not warrant the outlay of large sums, a product is being developed to give the necessities at minimum cost, while at the other end of the scale are coming more elaborate products aimed to supply everything that could be needed in a modern home, for people



In this unique tourist trailer coupling, the road shocks are absorbed by a pneumatic casing held by an aluminum frame which is fastened rigidly to the chassis of the tow car. The nose of the trailer pivots on the center of the casing spider, with the weight thrown just forward of the rear axle of the towing automobile

who have no other abode. And with this latter development goes a great deal of experimentation in design to the end that quarters will be less cramped.

The proponents of the home idea claim that no other suitable dwelling can be purchased at anywhere near the cost of a trailer. And this is true. The question remains as to whether present low-cost operation will endure. There are indications that the present advantage of escaping taxes and rent will not last. Not that imposition of taxes might be so onerous as to wipe out all advantage, but that the expansion of trailer use will lead inexorably to some payments which will raise operating costs. This year the question of trailer regulation will come up for consideration in the legislatures of several states, and out of these deliberations may come higher taxes (they are negligible now) and regulations which will force concentration of the trailers in suitably prepared camps.

The net result of legislative developments may serve as a damper upon sales, but it should in no wise prohibit them. The "escape" feature may be subordinated to eliminate mere social irresponsibility, leaving a means of living, the economy of which can be compared with fixed residence upon a more equitable basis. Wherever the earning of a living involves travel, the trailer has and will continue to have a prominent place. For those who have retired from active pursuits, it, too, promises a mode of living. Those who can afford a trailer in addition to a home will be in the market, and if they can't own, they'll be able to rent. But what of the person to whom home ownership is out of reach because of unsettled employment? Does it offer him a way out?

Trailers have been considered by those whose life work is the study of low-cost, mass housing for the worker and to date they do not see the trailer as affording any solution. They maintain that low cost housing has always been a problem of land economics rather than of building construction, that mobility is not a prime requisite, and that steady employment cannot be aided by it. They maintain that a large mobile population of workers would breed further unsettlement and make the tenure of employment even more uncertain than it is today.

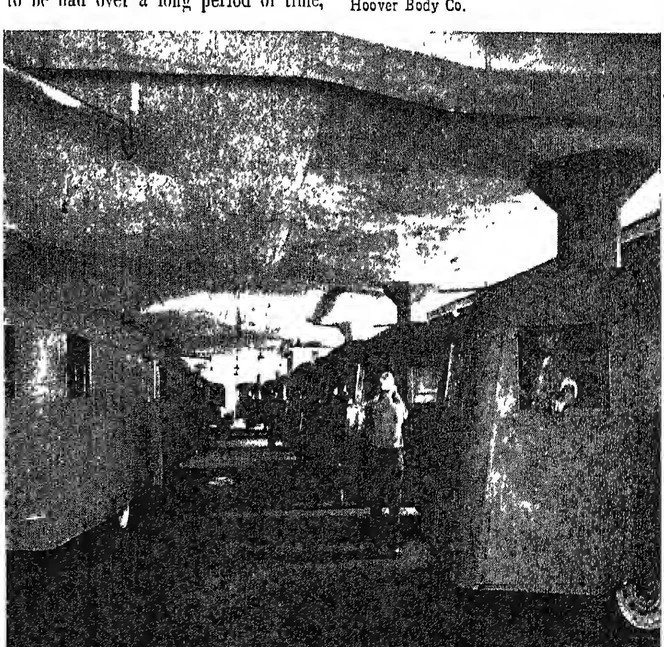
WHETHER or not the housing experts are correct in their interpretation of needs remains to be seen. The public may decide the issue. Sometimes problems are solved by those who barge in from other fields, knowing little or nothing about the obstacles to be overcome. Several enthusiasts for trailer living are struggling to perfect trailers that will overcome the limitations of space, now an inherent drawback, and provide a "packaged" home which will meet the needs for decent living. They vision an extension of municipal or private camps to dot the peripheries of large cities, where electric light, water, and sewage disposal can be had at reasonable charge. These colonies, they maintain, are a logical development because they permit families to live without heavy outlay for land ownership or rent, while enabling the bread-winner to get a hold in a gainful occupation.

The proponents of mass housing with trailers believe that a degree of fixity must go with the mobility if comfort is to be had over a long period of time, hence their designs tend toward an expansible type. If a trailer is to stay put for months, the owner may not mind a small setting-up operation. And so a new type of trailer is in the making. One current design resembles an orthodox trailer while on the road, but when anchored, the sides swing open to double the floor space. Another design, still on paper, calls for a two-story structure, while a third would have the trailer travel in two sections which could be "buttoned" together when the site is reached.

All of these behind-the-scenes developments make it obvious that the trailer industry is still in its formative stage and, therefore, passing through a period of instability. This is true despite the beginnings of mass-production with all that it implies in standardization. The present product can easily become standardized and still leave room for further development.

The immediate outlook for product development is for trailers with better insulation, adequate toilet facilities, standardized hitches, and more durable construction—in short, toward a normal improvement based upon lessons learned from service. Yearly models will record these advances. In viewing the immediate market, there appear to be no indications of a slackening of pace. Rather, expansion will continue until an equilibrium is reached, or until untoward social, legislative, and economic developments become influencing factors. As to what's to happen in two years or five years? The public will decide this unknowingly and your guess, the trailer manufacturer's guess, and mine, are equally good.

Photographs courtesy of Aerocar Co. of Detroit, Edwards Iron Works, Palace Travel Coach Co., Pierce-Arrow Motor Car Co., York-Hoover Body Co.



Coach trailers in all stages of assembly in a modern trailer factory

# Sense and Nonsense In Sensations

**Hunger and Thirst . . . Fatigue and Pain . . . Cold and Warmth . . . Smell . . . Sight and Color Blindness . . . Hearing . . . Our "Intelligence Department"**

By G. H. ESTABROOKS
Professor of Psychology at Colgate University

WHERE is *up?*"

"That," you say "is as silly a question as one could ask." Not at all. It is very dangerous for some persons to dive into water. Once under the surface they forget where "up" is and are likely to start for the top via China. This condition is caused by a curious disease of the inner ear, where is located a remarkable mechanism which keeps you friends with gravity. Ice and a smooth sidewalk give a most effective demonstration of gravity's force but this little organ in your ear keeps you right side up—with luck.

Its working is beautifully simple. Just imagine a very small rubber balloon filled with thin oil in which are floating little pieces of limestone. Now cover the inside of this balloon with tiny hairs, each of which is attached to a nerve, and you have the "saccule," as we call this organ. You can see how it acts. Gravity works on the limestone particles. When you are standing erect they rest on the bottom of the saccule, stimulating the nerves which say that you are upright. Lie on your side and they stimulate other hairs which indicate your position. Dive into water and you have an automatic device which tells you when you are standing on your head, as it were, and where to find the surface, even if you keep your eyes closed.

There is a funny little fish that sheds its skin every now and then. Along with the skin go the contents of the saccule, so the fish scrapes along the sea bottom filling its saccule with water and fine sand. Then the skin grows over the saccule and he is "all set." Observing this, one biologist had a brain wave. He filled the bottom of the fish tank with very fine iron filings, so that the fish got these in the saccule instead of sand. Then he needed only a magnet to make life miserable for the poor fish. When held over its head the magnet jerked the filings to the saccule's top. This meant that the fish was wrong side up, so he promptly flopped over on his back. Possibilities were infinite and the fish probably died of a nervous breakdown—a fit test case for the S.P.C.A.

If you are to survive you must be able to handle your body. The saccule and other structures in your inner ear take care of balance, which is tremendously important. These mechanisms inform your muscles what is happening and the muscles do the rest. But you've got to know what the muscles are doing, where your arm or your leg is and whether you are standing or sitting.

Again you say, "utterly silly! Of course I always know where my limbs are." By no means! Very important nerves run in from the muscles and joints which give you this information. At times they become paralyzed. For example, let us take the case of locomotor ataxia—syphilis of the spine. This disease always attacks the back of the spinal cord and here are located these nerves from the muscles—the kinaesthetic nerves. The syphilis germ kills them and as a result the individual literally cannot locate his legs. Lay him on his back, blindfold him, then put his leg in any unearthly position and ask him to touch it with his hand. He just can't do it. He also has a peculiar shuffling walk. He can't feel where his feet are, so he has to watch them. Now close his eyes and ask him to stand erect. You can do it easily, for the muscles of your legs keep flashing messages to your balancing apparatus and you just balance. You take it all for granted. But he will sway and fall —it is called Romberg's sign—because his muscles cannot send these messages.

The kinaesthetic fibers run up the cord to the brain, hence any injury to the backbone may very easily put them out of commission. Fractures or wounds, as well as disease, may give these curious results. Generally the legs alone are involved, because the nerves from the arms enter the cord high up. Any injury here generally results in a broken neck and death. In those rare cases where only injury occurs we get a weird inability to control the hands. The individual suddenly loses his power to play the piano, not because he can't move his fingers just as fast as before but because he can't keep track of them. They literally get lost.

"Let's eat," you say. "Why?" "Because I'm hungry." "And why are you hungry?" "Because I haven't eaten, you idiot." That's a very good reason—certainly good enough for most of us. But there is a much more scientific explanation of hunger. We can remove it with a very hearty meal of air. Hunger is caused by the walls of the stomach rubbing together, or by other movements in these walls. We have you swallow a small rubber balloon with a tube attached. Then we inflate the balloon. Result; no more hunger, because you have a "full stomach." Certainly a cheap meal and one which we would recommend to relief agencies if government money is not forthcoming.

And thirst? Much the same idea. There is a small area in your throat which tells you when you need water. It becomes dry because of insufficient water content in your whole body. Keep the area moist and you will not feel thirsty. People who live in desert areas have discovered this trick. They can walk in comfort under a hot sun and use about one fifth the water you would need. They swallow very little but keep the throat wet.

Now of course you are not fooling your body when you eliminate hunger or thirst by these trick means. These sensations are simply automatic whistles, so to speak, which tell you that the machine needs more fuel. You can turn off the whistle and the machine will still run, but you are drawing on the reserve fuel supply and sooner or later you will pay for it.

Similarly, fatigue is another of these internal sensations which warn us to ease up. It is caused by poisons, which

accumulate in the blood, acting on a center in the brain. Fatigue can be produced artificially. We simply take some blood from a person who is very tired, inject it into your veins and you promptly feel as tired as the blood donor. We can also turn off the sensation by means of hypnotism. Then the individual no longer feels tired but for a time can continue work greatly in excess of the normal performance. But again you are not fooling the body. You have just turned off the warning whistle and may suddenly find the subject in a state of collapse. For these purposes, the body is just a machine and when the fuel runs out, it stops.

SIMILARLY, pain is humanity's greatest blessing. It is nature's warning that part of the machine is either badly worn or broken—the danger signal par excellence. An appendix may give you a pretty bad time of it—but if it were not for the pain involved, you would go gaily along until it ruptured and peritonitis set in. Now we can turn off the signal here as elsewhere: hypnotism again can do it very nicely. Ether, or a dozen other drugs are even more effective, but your doctor is by no means as anxious to stop the pain as you are. It is about the only way he has of locating the engine trouble. Indeed, he would give a great deal at times if you would develop a good ache or two before it was too late. Some of our most dangerous diseases owe their bad reputation to just this trick. They keep under cover and don't give you even a twinge until it's all over. If cancer or tuberculosis, for example, just brought a good toothache in their early stages, we would reach the hospitals in time and thousands of lives would be saved. As it is, when detected, the battle is all too often lost before treatment even begins.

The sense organs we have mentioned thus far are the more obscure. Situated deep within the body, you are very likely to overlook them completely, centering your attention on the more evident senses of hearing, taste, or sight. Nevertheless, the sensations to which they give rise are absolutely necessary to a proper functioning of the body. Pain is peculiar, in that it can be aroused both inside and outside. It is nature's great and pressing danger signal—and danger exists everywhere. You would never know you had a speck in your eye, a tack in your toe or a burn on your finger if it were not for the pain receptors. They warn that something is wrong with the machine and insist on action. You get used to a bad smell very quickly. Taste is the same; also, very few of you have heard the clock ticking in the room for the last hour. But you can't lull pain away. If you have a bad tooth, nature doesn't play; you get no peace until you land in the dentist's chair—and precious little of it there, as far as that is concerned.

It is an interesting fact that the feebleminded are not nearly as sensitive to pain as are normal people, while some types of insanity are characterized by its complete absence. These people will stick needles and knives through various parts of their body with no ill effects other than the danger from infection, which, of course, is great.

The pain receptors outside the body are located in the skin but their distribution is by no means uniform. For example, you cannot prick your finger without getting the sensation of pain. If you even touch your eye ball it hurts, but you can thrust a needle through a fold of skin on your upper arm or back and the chances are that you won't feel it. This is because there are very definite sense organs in the skin and their location does not change. These skin senses involve not only pain, but also pressure and warm and cold spots. Each of these sensations has sense organs just as definite as the eye, even if microscopic.

Pressure spots are located all over the skin, especially at the bases of hairs. In the good old days before you became civilized, slight pressure might mean great danger. The walking of an insect across the skin, placing a hand on a snake or furry animal, would call this sense into activity. The whiskers of a cat or rat are further examples, while of course the "feel" of any object, from a toothpick or your own hat to the handle of your car in the dark, is largely dependent on this sense. All these skin senses yield very curious illusions. For instance, suppose you have a clean bone break in arm. If we bend the arm at this point the patient gets the same sensation as when he bends his elbow. Joint movements are always associated with pressure on the skin, and the sensation is simply carried over to this false joint.

Some 250,000,000 years ago, nature decided on a new model. This was to be temperature conditioned. So she brought out the mammals and birds—so-called warm-blooded animals—which means that the body stays at that constant temperature which is most efficient for the working of the machine. It is a terribly wasteful arrangement because four fifths of all the food you eat goes to keep up the fires—only one fifth to movement. But it gives you one enormous advantage over the reptiles and the fish. Cold or heat, unless extreme, mean practically nothing to you, but at freezing weather, a snake or any other cold-blooded animal simply stops. The machine just won't work, because its temperature falls to that of the air about it. As a result, the great race of dinosaurs, huge reptiles which once ruled the earth, were swept out of existence by these new-model animals, the warm-blooded mammals.

You keep your house constant in temperature by means of a thermostat, but nature has a device which makes this look crude. The sensations of cold and warmth, the so-called "temperature" senses in your skin, are simply very efficient little thermostats installed to keep your machine at its best running temperature. On a hot day they warn you to go into the shade or the water, otherwise the engine will boil. You put your nose out when it is ten below zero and you know that plenty of clothes and fast walking are indicated or else the engine literally will freeze. Your body adjusts itself to the temperature sense so beautifully that you rarely realize what you are doing. An extra jersey in winter or cottons in summer are the more visible signs. Actually you are continually changing your position, drinking this in summer or that in winter, eating more meat and fat at one season, fruit at another, all because the "air conditioning" apparatus is always at work keeping the machine at its best running temperature.

There are two other senses and these intimately associated, namely smell and taste. In reality, you taste very little. The wonderful taste of roast beef, coffee, or pickles is almost entirely a matter of smell. The sense organs of taste are located in the tongue and other parts of the mouth. They can detect only four qualities—sweet, salty, sour, and bitter. Smell has its center at the back of the nose. Anything which approaches or enters the mouth must stimulate this area because of the air currents continually in circulation. You complain that you lose your taste during a bad cold: what really happens is that your nasal passages are blocked and so you lose your smell of the food, which is the most important part of "taste."

YOU can play some interesting tricks on yourself, which very nicely illustrate this dependence of taste on smell. Close your nose with a clothespin, cotton, wool or any other device. Now blindfold yourself, so you can't see what you are eating. Under these conditions you will find that the best roast beef and gravy taste exactly the same as sawdust probably would taste. Mashed potatoes are indistinguishable from mashed turnips, finely ground dog biscuits, or pulverized leather. I should add that it is always best to have a friend whom you can really trust working with you on this experiment, or else your stomach may get a few surprises. Believe it or not, cream and castor oil cannot be distinguished, while I actually saw one boy swallow a tablespoonful of paraffine and ask for more—also for the privilege of murdering his friend when he later found what he had done.

Your eye is, of course, the world's most wonderful camera. The best product of modern science is crude in com-

parison. The eye itself is simply a marous apparatus to focus light rays on plate—the "retina" we call it. Now then, parts of the camera go wrong. e lens—it goes by the same name in eye and serves much the same purie—does not function properly and become short sighted or far sighted, its curvature is not perfect and you e astigmatism. Glasses correct these lts. Much more serious is the collecn of white matter in the lens when the y serious condition of cataract deops. This calls for heroic measures, the modern surgeon takes the lens out mpletely and gives you glasses to comnsate.

Sometimes the optic nerve itself dies, d this, of course, is incurable. Certain diseases may lead to blindness—syphilis and tuberculosis are offenders here—while, of course, accidents can do the same. It is interesting to note, however, how difficult it is really to get at the eye. It is situated in a bony socket and these bones can absorb a terrific blow without the eye itself being injured. Pointed weapons are the great danger and, of course, the flying glass from automobile windshields qualifies very nicely under this head. When plans for your eye were drawn up, however, many millions of years ago, even the Model T hadn't made its appearance. So be charitable if nature falls behind a little—consider the football rules.

THE camera plate itself, the retina, is our chief point of interest in the eye. Here are located the real organs of vision, the rods and cones. These have two separate functions. The rods detect movement and changes of brightness, the cones react to color. Strange to say, the lower mammals, such as the cat, dog or bull, are color blind. This is difficult to demonstrate, but it can be done. Then, for some reason or other, when nature got to man, she decided to introduce color vision in her latest model. So now both you and the bull can "see red"—but the bull can't!

But man is a backslider, here as elsewhere. Every now and then he arrives minus this latest device, and we have the color-blind individual. If he is totally color blind, he sees no colors at all. If "red-green" color blind, then he cannot detect these latter. Red-green color blindness is present in at least 5 percent of males but in a much smaller percenttage of females.

Your ear gives us a marvelous example of just how clever nature can be in this matter of sense organs. First we have the passage leading to the ear drum. Sound waves striking this membrane start it vibrating and three little bones, very neatly jointed, pick up these vibrations and carry them across the "middle" ear to the "inner" ear. This middle ear is a tiny bone chamber filled with air. Here nature struck her first major problem—that of varying air pressure. If you go up a mountain or down a mine, the air pressure outside changes, the ear drum gets pushed in or pulled out, can no longer vibrate and you get that curious deaf feeling, best encountered in an elevator. What to do about it? Nature put through a tunnel from the throat to the middle ear. Every time you swallow this opens and equalizes the pressure inside and outside the ear. Unfortunately this tunnel—the eustachian tube—carries the possibilities of infection. Germs from the throat travel up it and attack the middle ear. Mastoid disease is one of the results.

The organ of hearing itself is one of nature's masterpieces. She simply installed a tiny piano keyboard in each inner ear. To be sure, it is microscopic in size and has a few curious features, but the fundamental idea is there just the same. From the end of each string a nerve goes to the brain and in this way you hear. But how to play it?

The board is in a winding chamber filled with a very thin liquid. Vibrations from the air are picked up by the ear drum, relayed across the middle ear by the three little bones aforementioned and passed on to the liquid in the inner ear. The strings vibrate according to the principle of "sympathetic resonance." You have heard a window pane rattle on playing a certain piano note. Similarly, the strings of a violin or piano will vibrate when they are in perfect tune with a note played on another instrument. They just pick it out of the air. So your ear keyboard picks it out of the liquid in which it is immersed and the various strings vibrate in tune with the vibrations in this liquid. The nerves carry this to the brain, and so you hear.

The sense organs form the intelligence department of the body. It is their duty to keep you posted about what is happening both within and without. At times they can be fooled or will make curious mistakes. Certain diseases will cause you to see anything from streaks of light to snakes. Under hypnotism you can hear Caruso singing in the spirit world or "Big Ben" broadcasting from London—without the radio. Then we have a whole store of trick illusions in the psychological laboratory. With these we can make you swear that lines of the same length are different, that different colors are the same, that hot is cold and that bad smells don't exist.

For all that, the sense organs of the body do a good job—and they should. Your eye, for example, is the direct result of more than 500,000,000 years of evolution—and that is a long time.

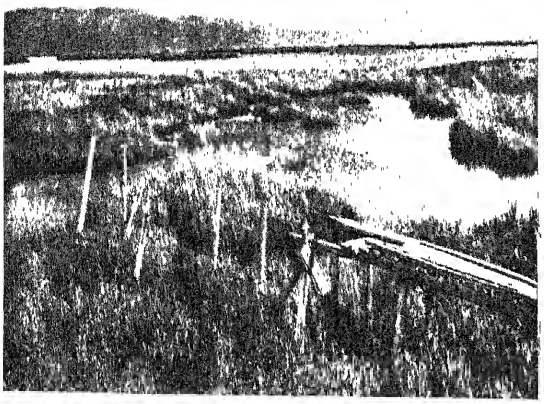
In closing, we would like to stress two very interesting facts. Not only do we deal with immense periods in evolution, but also with a highly varying rate in different species. For example, 50,000,000 years ago parrots existed which were practically identical with present-day species. Man is very much a newcomer and, should you meet your ancestor of but 50,000 years back—the so-called Neandertal man—you would certainly never invite him to lunch. Short, squat, hairy, with receding brow, magnificent teeth and immense physical strength, he would probably have much preferred eating you to eating with you, for he was a cannibal, among other things. Some species were born only yesterday and are still rapidly evolving. Others have remained as they are for a billion years, watching the race go by.

This same picture holds in sensation. As evolution advances, we place more and more stress on those sense organs which enable us to analyze the world in which we live, particularly stressing eye and ear. In physical strength, coordination and speed, a cat can literally make a monkey out of a monkey, while if we match a man and a tiger of equal weight the result isn't even worth a good bet, despite the higher intelligence of man or monkey. Physical efficiency is, of course, just as much a matter of kinaesthetic sensation as of muscle tissue. Similarly, in smell man's best is just nothing, compared with a dog's keenness in this sphere.

But here the superiority ends. Man now lives under conditions where careful analysis of a very complex environment is essential. The dog, for example, cannot distinguish different tones, nor can any other animal. A violin sonata is, to him, just noise of varying intensity. He would certainly prefer the jazz orchestra. Nor can he see color, strange as this may seem. The red flag means nothing to the bull, so far as color is concerned, while green or blue would be just as annoying, but this color vision enables man to know his world far better than any animal.

Finally, man specializes on *fine* coordination. The tiger—even the monkey—may surpass him in strength and use of the big muscles, but just watch your best-trained chimpanzee try to thread a needle or use a fork, and you realize that man is his superior just where this superiority is most needed. Our kinaesthetic senses allow us to handle a pen, shoot a gun or grind the valves of a motor—activities which are essential to our life and happiness but which are completely beyond the scope of any lower animal. That makes sense in our world of sensation and gives us the prize, even if the monkey can hang by his left hind leg from the tree tops.

*IN stating that man—*Homo sapiens*—is the descendent of Neandertal man, the author follows the school of thought of Dr. Ales Hrdlicka of the United States National Museum. The question is not yet finally decided.*—The Editor.



A fine example of a waterfowl marsh area at Red Rock Lakes, Montana

# FLOODS AND WILDLIFE

## Flood Control and Wildlife Management Can Be Correlated . . . Proper Dam Design Creates Wildlife Refuges . . . A Three-in-One Program


By IRA N. GABRIELSON

Chief, Bureau of Biological Survey, United States Department of Agriculture


THE disastrous floods that occurred during the spring of 1936 have focused national attention upon the problem of devising methods to control the runoff of water and prevent recurrences of seasonal catastrophes of this sort. The last Congress authorized a gigantic flood-control program and this action has probably been most effective in acquainting the public with the fact that devastating floods are not necessarily to be classified as "acts of God," or inescapable natural calamities which must be endured. Rather, they are often the result of our own mismanagement of a great resource. Since this is so, then it is obvious that flood damage can be prevented or at least greatly reduced by substituting good management for bad and by applying sound and sensible methods to the problem of water conservation and control. The problem primarily is one for our engineers, but all those agencies concerned with the conservation and restoration of our renewable organic resources have, also, a tremendous interest in what may be done. No money for the flood control problem has yet been appropriated but the public's vivid recollection of the terrifying and destructive events of the past year will undoubtedly compel protective action on an extensive scale in the near future.

Wildlife conservationists in particular are becoming increasingly interested in this program and its possible effects on wildlife populations. The idea of control meets with their general approval, for floods are disastrous to small ground-inhabiting mammals that find it impossible to escape the rush of rapidly rising waters. When floods come during the bird nesting season, wide-spread destruction of this valuable form of wildlife is the inevitable result. Migratory waterfowl and other marsh-nesting species are especially hard hit by upward fluctuations of water levels during their nesting and rearing seasons in May, June, or early July, while the plants upon which they feed are destroyed or prevented from growing at all in waters subject to frequent violent changes of level.

THEREFORE the flood control program holds a vital interest for those concerned with the increase of the nation's wildlife resources. Such a program will, if wildlife needs are considered, add materially to these resources, or, if no consideration is given, it will cause concentrated damage of the kind that such resources have been subjected to almost every year in the past.

Official conservation agencies, both Federal and State, are now spending great sums of money in attempting to restore migratory waterfowl and upland game resources. They must spend still more if these efforts are to succeed, and it seems pertinent, therefore, to point out any expedients which may allow the flood-control program to contribute to that end.

Waterfowl need comparatively stabilized water levels for proper environment, while flood control, if dams are built solely for that purpose, might require huge storage capacities which would permit water to be fed out into the streams in a regulated flow over a long period of time. Such dams can serve no useful purposes for migratory waterfowl and their catch basins would often



The huge death traps for small game which had taken up its abode therein during the dry season. Seemingly the two purposes are incompatible, but actually there are methods by which the needs of migratory waterfowl and small upland species may be met in some degree without excessive in-

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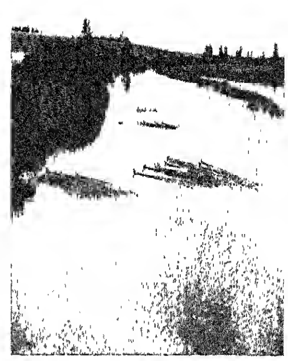


Four broods of ducks on the Lower Souris Refuge

excessive run-off, might well replace a single but much larger and more expensive structure farther down the stream. In other words, water may sometimes be more cheaply and effectively controlled in small volume than in huge quantities. Such small dams would have the added advantage of preventing soil erosion and would slow up siltation farther down streams.

Whether large or small dams are required, wildlife administrators realize that the number, location, and size must be worked out by engineers to meet the special problems of each stream. It would seem entirely possible and reasonable that some of the larger dams be built to hold shallow lakes at a stabilized level which could be maintained by the normal flow of the stream. Storage capacity above that level during flood periods, while somewhat interfering with wildlife and occasionally causing serious loss if it were required during bird-nesting season, could still provide some first class feeding and resting grounds in sections where such areas are now lacking. They would frequently if not always provide fair nesting conditions as well.

A fine example of how large dams may help the wildlife resources is developing now on the Upper Mississippi River Wildlife Refuge near Winona, Minnesota. Two of the pools created here by the flood control and navigation dams have relatively stabilized water levels. These dams, which might easily have been so designed as to destroy most of the wildlife value of this great area, are actually increasing these values. In the shallow portions of these stabilized pools, which lie outside the navigation channel, water plants, both the submerged aquatics and the emergent vegetation favorable to waterfowl and other marsh-loving birds, are establishing themselves in abundance. If these waters are held at their present levels an outstanding waterfowl habitat will have been produced and maintained. It is improving steadily and is at the present time a concrete example of what advance consideration can do for wildlife in the planning of these major structures. In this instance Army Engineers at the request of the Biological Survey altered their designs for the dams to meet the needs of the wildlife refuge.

A somewhat different type of structure exists today on the Upper Souris Migratory Waterfowl Refuge which, while built primarily for storing water to maintain nesting marshes below it on the river, was also designed with the added purpose of providing flood protection to the city of Minot, North Da-

With the Upper Souris Dam in operation, floods will never again sweep through the city of Minot, North Dakota, as in the photograph at right above

A drainage canal carrying water into the Clear Lake Refuge in California

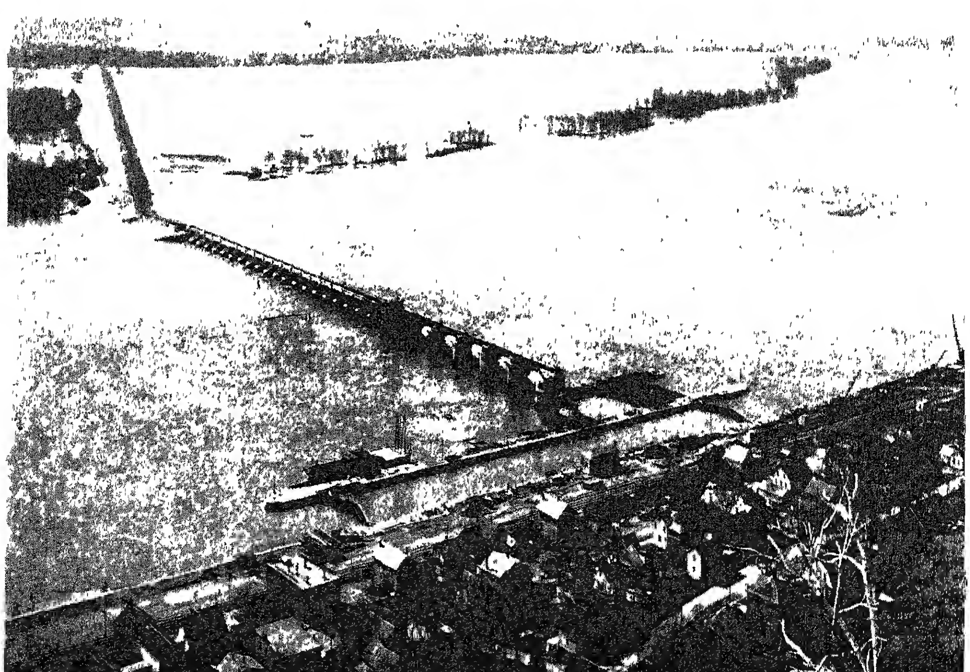
kota, below it. It creates an artificial lake which at its maximum will be some 28 miles long and 21 feet deep.

Such a lake may be raised a foot or sometimes more without great harm to cover or animal life, provided that the additional flooded land is not covered for an extended period. In very flat terrain such water would spread farther and perhaps do more harm than in lakes with somewhat precipitous banks. In any event the harm is minimized and a stabilized water level provided which will be of great value to wildlife. Temporary deepening of the waters during flood stages is not good for aquatic vegetation, but dropping the water or drawing it entirely away is much worse.

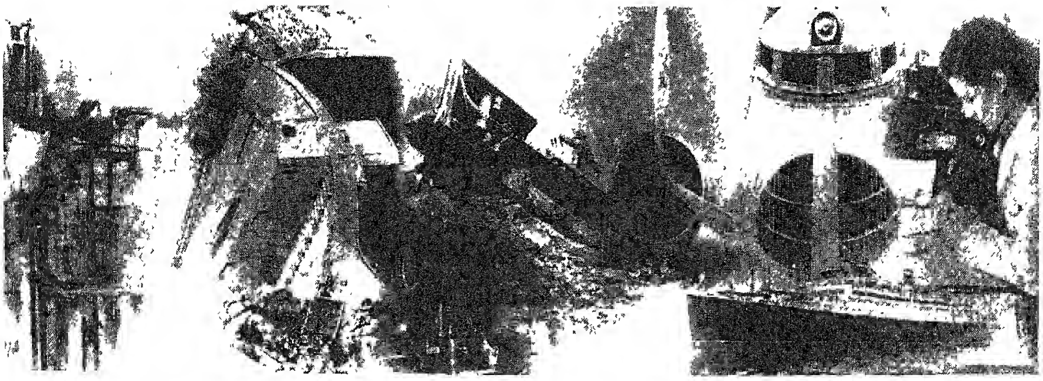
Dams can be easily designed to maintain minimum water levels and to provide temporary storage above that level sufficient to take care of sudden excessive floods. The Souris Dam mentioned above is of that type. It is equipped with gates which can be opened to carry the full channel flow of the river and a spillway which provides an additional safety factor in excessive quick run-off.

Should a sudden flood develop when the storage capacity was already utilized, the spreading of the flood waters over the comparatively vast area of the lake will greatly minimize the effect of any except extraordinarily prolonged run-off. In other words, the lake itself will act as a stabilizing influence.

Wildlife groups would like very much to see consideration given to these types of flood control structures. They believe they will be of great and lasting benefit to the public from the standpoint of preventing soil erosion, conservation of forests and farms by holding advantageous water levels instead of allowing all of the run-off water to hurry out of the country, and that at the same time they will provide much better conditions for wildlife. This latter consideration is of prime importance in the northeastern states where few places exist in which water storage and conservation for the benefit of migratory waterfowl restoration is possible. The cost of the structures required is too great to justify the work for that purpose alone, but when combined with flood control it becomes much more feasible and practicable. In any event it would seem to be the peak of extravagance and folly to take less than we can get for our flood control money. If, by taking thought, we can prevent this type of water damage and at the same time realize tremendous additional benefits in the way of wildlife restoration and soil conservation and have all three at the price of one, then it would seem to be well worth while to give consideration to the foregoing program.



The Alma Dam on the Upper Mississippi is stabilizing water levels to the benefit of waterfowl



# THE SCIENTIFIC AMERICAN DIGEST

**Conducted by F. D. McHUGH**

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## Huge "Ice-Pack" Saves Dam

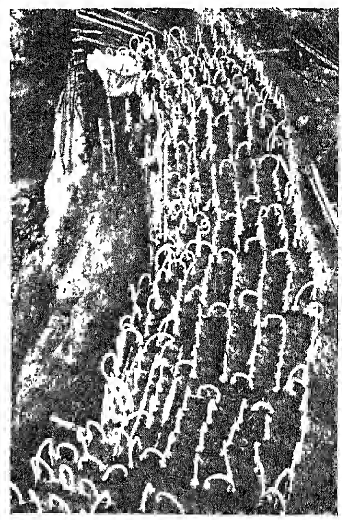
ENGINEERS on the Grand Coulee Dam project were recently faced with a serious problem. The foundation of this dam is of exceptionally fine massive granite lying 500 feet below a layer of glacier-deposited pulverized earth. Now this earth is comparatively stable when dry, but when moistened or disturbed, either by excavation or by the cutting action of the river, its stability is disturbed and it flows like molten lava.

Since excavation was started on this project there have been several "flows" of this earth which encroached upon the work. Some of the flows were stopped by draining off the excess water, others were stopped by shoveling off part of the overburden, a very slow job.

Recently an earth flow resulted in the most serious situation faced since construction began. It started as earth was being removed from a gulch in the bedrock, 120 feet deeper than the average bedrock surface and 117 feet below the low-water surface of the river. It runs parallel to the river and apparently was cut in some past age by the stream. The sides are very nearly vertical and are from 60 to 100 feet apart.

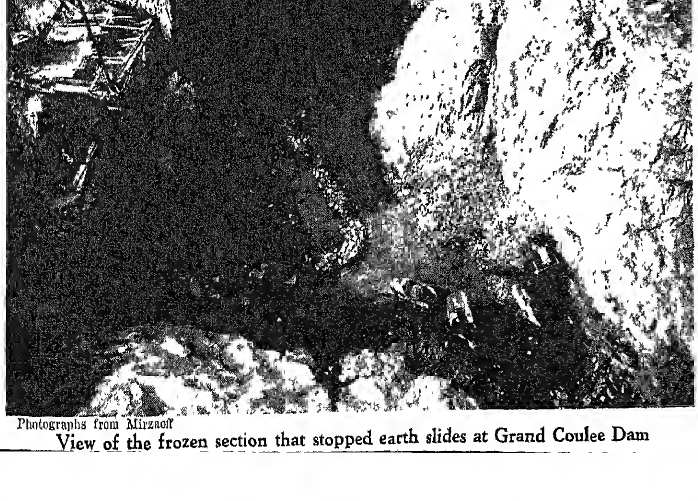
When this gulch was nearly emptied of earth, the great bank above it began to slide into the excavation from the upstream end. It moved at the rate of about two feet an hour and engineers estimated there were more than 200,000 cubic yards of earth in motion. Power shovels at work could not hold their own and were forced to retreat to keep from being buried.

Engineers in charge of the dam decided upon an experiment in which the earth at the base of the slide would be frozen, forming a dam to hold back the remainder of the earth until concrete could be poured to an elevation higher than the sliding earth.



Frost-coated brine-carrying pipes that formed the dam-saving ice pack

Two refrigeration machines were brought to the site. They had a total capacity of more than 80 tons of ice a day. About six miles of pipe were driven into the sliding mass in the form of an arch at the head of the gulch. Brine was forced through these pipes at a low temperature and the earth frozen. The dam thus created has a crest length of 105 feet. It is 25 feet thick and 40 feet high. The major test was placed on this unique structure when the earth had been removed from in front of it. The surface of the foundation rock was smoothed by blasting. Even this did not damage the frozen dam. Flying rocks cut a few pipes in the exposed face of this strange structure, but repairs were made quickly and it did not fail.



Photographs from Mirzaoff

View of the frozen section that stopped earth slides at Grand Coulee Dam

## Gas From Coke

CONVERSION of solid fuel into gas and liquid products is an important factor in modern utilization of fuels. Experiments recently made at the University of Michigan have shown that powdered coke treated with sodium carbonate solution can be completely converted into gas by falling through a tube containing a mixture of steam and oxygen heated to 900 degrees, Centigrade (1650 degrees, Fahrenheit). In the experimental unit, a steel tube two

inches in diameter and eight feet long served as the furnace. Apparently the presence of a small amount of sodium carbonate on the surface of the coke materially increases the speed of gasification. The process may have important value in the manufactured gas industry.—*D.H.K.*

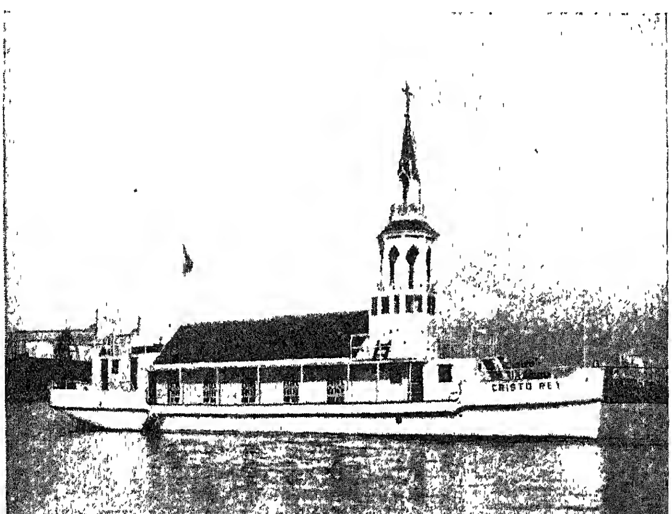
**NEWSPRINT**

**THE newsprint used yearly in the United States would make a sheet 450 feet wide from the earth to the moon.**

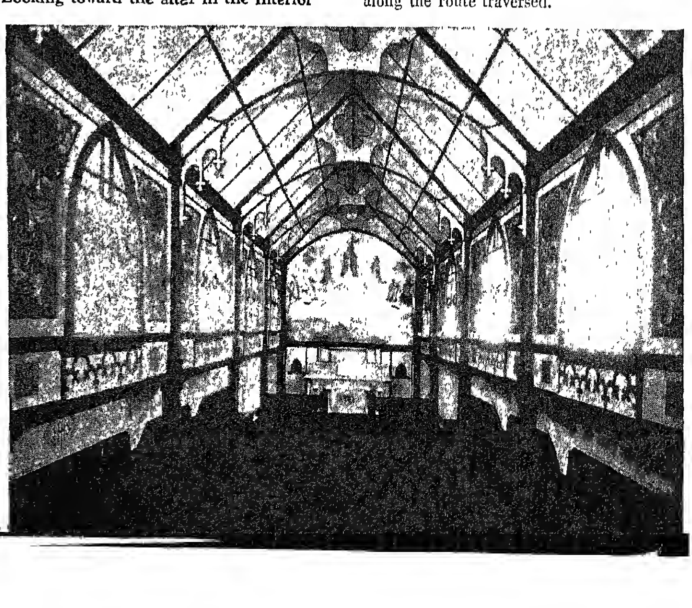
## World's First Floating Church

GETTING to church has always been a problem on the delta of the Parana River in the Argentine. Church-goers have had to ford many of the streams which thread the delta or miss formal worship. Recently the problem was at least partially solved. The answer, supplied by a practically minded padre and illustrated here, is the world's first floating church. Now the place of worship, with its steeple, stained glass windows, padre, and altar goes to the congregation!

This floating church, 108 feet long, was built in the Argentine government's Buenos Aires shipyard. The hull is that of an old vessel. It was transformed into a place of worship by the modern Lincoln electric arc process of welding.




***Above:* The floating church that brings services to residents of the delta of the Parana River in the Argentine. *Below:* Looking toward the altar in the interior**



## Cheerful Cancer Figures

THOSE who have been worrying over the menace of an increasing cancer death rate can ease their fears and take heart from the optimistic note on cancer struck by recent figures of the Metropolitan Life Insurance Company. The increase in the cancer death rate during recent years is more apparent than real. No more people are dying of cancer now than 25 years ago, but more cancer deaths are being recorded because of better diagnosis. In certain groups, notably white women between the ages of 35 and 54, the death rate has declined significantly in the past 25 years. Only over the age of 65 has the cancer death rate for white women shown an upward trend.

These figures are from the findings of a survey of cancer deaths among the company's industrial policy holders during the past quarter century.

Even among white males the cancer death rate is not quite a third higher than that of 25 years ago. This increase, it is believed, is due to improved diagnosis, more cases being recognized now as a result of improvements in modern medicine during the past quarter century. These improvements in diagnosis have caused an apparently greater increase in the cancer death rate for men than for women in the 25 years, because in men cancer occurs more often in internal organs where it was not easily accessible for diagnosis.

Bearing out the point that the increase in cancer deaths is more apparent than real, is the fact that the recorded death rates from cancer in accessible places have declined while those from inaccessible cancers have increased.

Other hopeful developments in the cancer situation in the United States are the growth of facilities, both public and private, for treating cancer and the improvement, as a result of special training, of the physician's ability to diagnose and treat cancer effectively.

Also encouraging is the fact that between 1932 and 1935 the American College of Surgeons collected data on 25,000 patients living five or more years after treatment for cancer without recurring signs of the disease.—*Science Service.*

## Soybean Flour Destroys Vitamin A

FLOUR made of legumes, particularly soybeans, and added to bread to improve the color of the crumb has been found to destroy its vitamin-A content. The color which is removed by soybean flour is carotene, which is oxidized and hence decolorized in the process. Since carotene is the basic substance of vitamin A, its activity is thus destroyed. Similar tests with cod-liver oil have shown that soybean flour will destroy at least 99 percent of its vitamin-A content.—*D.H.K.*

## Silent Trolley Cars for Brooklyn

CONGRATULATIONS, heard because they are not drowned out by conventional and unavoidable rumble and clatter of trolley cars, are now forthcoming from residents of Brooklyn, New York, as the first of the hundred new silent type "PCC" cars for the borough are being put in service by the Brooklyn and Queens Transit Corporation. Citizens of all ages, who long ago gave up trying to make themselves heard when a trolley went by, are being agreeably surprised by the new vehicles, evolved by operators and manufacturers after five years of research. The new cars add but a whisper (actually) to the proverbial roar of the city, thanks to the use of rubber in a new way in the construction of the trucks and wheels.

A special study was made of the interior lighting of the cars, and as a result the Brooklyn vehicles are in all probability better lighted than the majority of the homes along the route traversed.

### BICYCLES

SINCE we have been scolded for not including bicycles in our Transportation Issue, we will complete the issue with the surprising fact that bicycle sales for 1935—the automobile era—were greater than at any time since the peak sales of 1899—the horse and buggy era—and when figures are available, 1936 will probably show *larger sales* than those of 1899.

## For 80 Years!

ALL told, perhaps a hundred of our readers have been with us regularly for 50 years or more. They've followed in our pages the steady march of science from the "early days." Some of them have written from time to time expressing their belief, as the late Hiram Maxim did, that they *must* be record-holders. Not one of them was!

We pay tribute here to Mr. Oscar Laighton who, without a doubt, is *the* record-holder. Mr. Laighton, whose home is the Isle of Shoals, off the coast of Maine and New Hampshire but who winters in South Carolina, says he has read Scientific American for 80 years! At the age of 98 he is still keenly alive to the spirit of progress that has builded this nation. From his letters, we see in him incarnated the sturdiness of New England; the gentleness of the poet who loves every stone of the land of his nativity, every flower, every bird song; a generous and a

kindly soul. He is a brother of the New England poet, Celia Thaxter.

Thank you, Mr. Laighton, for your long years of loyalty. May the future years deal gently with you.—*The Editor.*

Ventilation was also considered in planning the "PCC" car, and among the attractive features are ducts leading from the motors up through the sides of the car to insure clean air inside.

No discomfort in starting and stopping is experienced by the passengers, because of the increased number of resistance points on the controller. There are 260 notches, or control stages, in the electric

One of Brooklyn's new high-speed, silent trolley cars

operation. A smooth acceleration of from four to four and three-quarters miles per hour per second is obtained—more than twice that of the conventional street car. In five seconds the new vehicle can attain a speed of almost 24 miles per hour, and *it can reach 50 miles per hour in less than eleven seconds.*

The car can be stopped in about 70 feet when it is going 24 miles per hour, the service braking rate being from four and a quarter to four and three-quarters miles per hour per second, and the emergency rate from eight to nine miles per hour per second.

Three types of brakes are employed, operating in sequence from a single pressure on a foot pedal. A dynamic brake acts on the motors, a magnetic brake on the track, and air brakes on the wheels. The latter completes the stop and holds the car. There is no sudden jar when the car is stopped, but a quick and smooth slowing down, effectively insuring against skidding and stopping rates of the new trolley cars substantially exceed those of the ordinary passenger automobile. A quiet hum is the only audible evidence of increasing speed.

Operation of the new street cars is particularly safe and simple. The motorman employs a foot-brake and a foot-accelerator, and his hands are completely free.

Electric equipment for the hundred Brooklyn cars was designed and built by General Electric. Similar vehicles are also on order for Chicago, Pittsburgh, Baltimore, and Los Angeles.

## PULP-MAKING WITH AMMONIA

A NEW method for pulping wood in the process of paper making, substitutes ammonia for dolomite rock as a raw material. Pulp has been made on a large scale by digesting wood chips with sulfite acid liquor made by treating dolomite with water in which sulfur dioxide is dissolved. pulp from which the better grades of paper are made. In the new process ammonia is used instead of dolomite in the preparation of the sulfite acid liquor. This new method has been tested on a full-plant scale in Norway for several years and the results in producing a high grade pulp, free from ash, in a shorter cooking time at lower temperature than by the older process, have encouraged expansion. The process consumes ammonia now cheaply available by synthesis from the air. Commercial development of the process in Norway is being fostered by Norwegian ammonia producers in co-operation with existing paper pulp interests.—*D.H.K.*

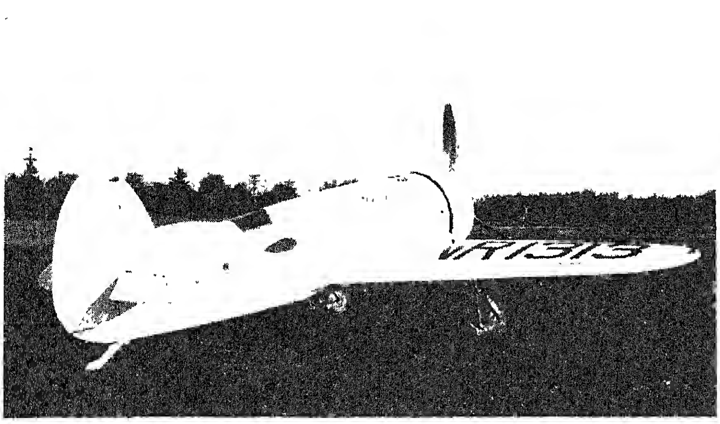
## SKUNKS PAY DEARLY FOR THEIR INDEPENDENT ATTITUDE

SKUNKS are traditionally about the most independent animals one is likely to meet. Secure in their formidable means of defense, they stand their ground against all comers and let the other fellow get out of the road. But they are paying dearly for their failure to recognize something more formidable than themselves—the modern automobile, that can rush up on them and annihilate them before they have time to unlimber their gas-warfare artillery. So dead skunks are found on the highways, far out of porportion to their relative abundance among wild animals, according to *Science Service* and the journal *Science.*

On three recent drives in the region around Washington, D. C., totalling about 600 miles, B. H. Wilford and J. F. Wilford counted 22 dead skunks. They saw no other dead animals at all.

## MEETING MODERN LUBRICATION NEEDS

"GIVE her another quart of oil," is the motorist's simple answer to the problem of lubricating the small, powerful engine which drives the modern automobile. Yet behind that "quart of oil" is a vast amount of the most painstaking research to provide in it exactly the characteristics



*Time Flies*, Commander Frank Hawks' new ship described below

machine in continuous efficient operation.

Recent rapid developments in automotive engines have greatly complicated the lubricating problem by imposing heavier loads on bearings and by widening the range of temperature over which they operate. Since the function of the lubricant is to form a continuous thin film between the metal surfaces of the bearings, this has necessitated the finding of oils and oil mixtures capable of maintaining lubricating films under the newly severe conditions imposed. In addition to new refining methods designed to remove undesired and objectionable impurities from the oil itself by the action of solvents, modifying agents added in small amounts to the refined oil impart valuable characteristics to it.

The whole cycle of development of lubricating oils today has been compared with that of steel and its alloys. The new superrefining methods using such solvents as dichlor-diethyl ether, furfural, propane, and others are similar in their effects to the modern steel refining methods and the addition of modifying agents to the refined oils corresponds roughly to the alloying of metals.

Among the agents found valuable in increasing the strength of the lubricating film produced by oils are, strangely enough, a variety of chlorine compounds which of themselves are not lubricants in the ordinary sense. Such materials as methyl dichlorostearate have been found to be particularly valuable.—*D. H. K.*

## "Time Flies"

APPROPRIATE is the name—*Time Flies*—of the new ship designed and built by Commander Frank Hawks and Howell Miller, under the sponsorship of the Gruen Watch Company. The new ship, the aerodynamics of which were checked in the wind tunnel at New York University, has a well defined objective—to combine the high speed of a racer with the practicability of a modern light transport plane.

*Time Flies* is passing its tests brilliantly; equipped with a twin Pratt and Whitney Wasp, developing 1150 horsepower, it is expected to have a cruising speed of 340 miles per hour, and a top speed of 375 miles. The wing span is 31 feet, length overall is 22 feet, and the wing area is 160 square feet. There is a very complete instrument installation including a Sperry Gyropilot; a 230-gallon fuel tank carried engine gives long range. The landing gear is fully retractable and the clean and modern lines of the ship are clearly seen in the photograph.

There is one particularly good idea which Frank Hawks, fine pilot and instinctive engineer that he is, has brought forth for the first time in aviation history; the complete elimination of the windshield.

The disappearance of the windshield has of course greatly enhanced the streamlining. The pilot is seated well to the rear. The cabin conforms to the line of the fuselage without a break. How can the pilot see? In flight he has flying vision through top and side windows. For landing and take-off the seat may be raised by a manually operated hydraulic jack and in the raised position the pilot's head is above the line of the fuselage so that there is wide vision ahead and to the sides.

A very simple idea, readily realized. But it was Frank Hawks who had to think of it.—*A.K.*

## Bombers Have The Edge

LIEUTENANT-COLONEL Robert Duncan Brown, of the Coast Artillery, in a recent talk before the Reserve Officers Association, gave it as his opinion that at the present time airplane bombers have the edge over anti-aircraft guns.

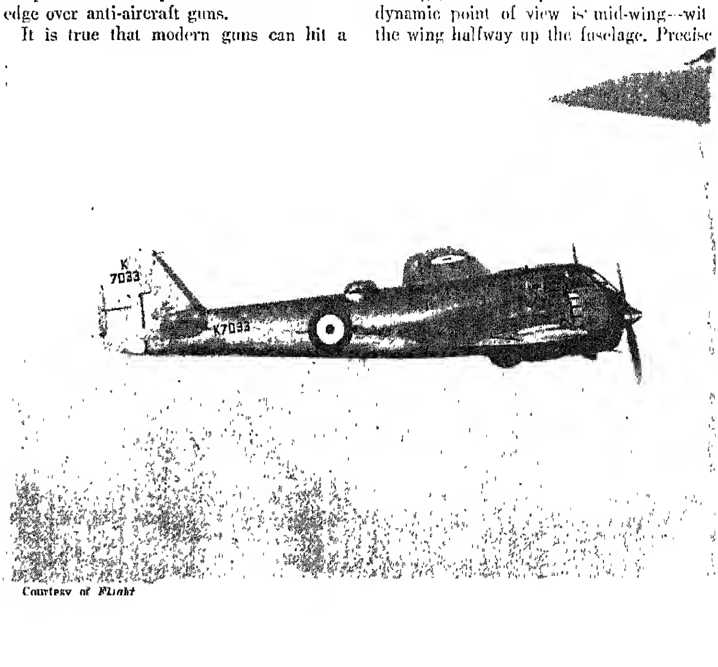
It is true that modern guns can hit a towed target two times out of three, but a target can only be towed at 120 miles per hour, while the bombing plane may fly at 250 miles per hour. Modern searchlights under perfect conditions can penetrate a distance of 25 miles, but are useless in fog. The tremendous speed of modern planes gives them a practical if not theoretical advantage. The Colonel's gunners fixed their searchlights on 13 out of 21 attacking planes, but managed to shoot at only two, even though the spotlighted planes obligingly landed and played dead. Probably the worst problem of anti-aircraft defense is dive bombing. There are only two defenses against dive bombing—hitting the plane before it starts to dive, or putting such a barrage into the "elbow" (the place where the ship points its nose down for the dive) that the pilot is afraid to venture into the maneuver.

On the other hand, bombing in the last two years has made such enormous strides that the bombers can hit their objective from a height of 17,000 feet with deadly regularity.

There is always a struggle in military tactics between offense and defense. At the present moment attack seems to be definitely in the lead, at least so far as air warfare is concerned.

In view of this situation, it is not out of place to examine a photograph of one of the very latest British bombers, the Bristol-Blenheim twin-engined monoplane equipped with two Mercury 840 horsepower engines. Its civil forerunner, mounting le[ss] powerful engines, attained a speed of 2[..] miles per hour, so the rumor that British bombers have speeds in excess of 3[..] miles an hour is probably not far out.

A photograph such as the one shown carries many lessons for the airplane designer. We note that the entire nose and sides of the fuselage is one almost unbroken expanse of glass. The line of the fuselage is a stream-lined sweep from nose to tail, with the rear gunner enclosed in a glass cov[er]ed cockpit. There has been much co[n]troversy whether wings should be hig[h] (above the fuselage) or low (below th[e] fuselage). The best position from an aer[o]dynamic point of view is mid-wing—wit[h] the wing halfway up the fuselage. Precise



Courtesy of *Flight*

ly this arrangement is adopted in the Bristol-Blenheim. There are structural difficulties in carrying the wing loads through the fuselage, but these have evidently been surmounted. Another interesting feature is the large proportion of the rudder which projects in front of the hinge to act as a balance. With this balanced portion and the little tab or trimmer at the rear of the control surface, such a rudder is very easily actuated no matter what the speed.

So little information is available on military machines that designers pounce avidly on such photographs as the one reproduced here.—*A.K.*

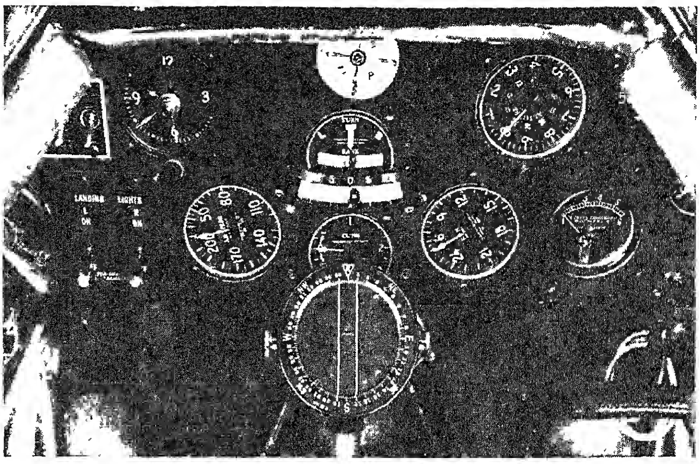
**DIESELS**

**IS there any good reason why almost everyone continues to capitalize the initial letter of the word "Diesel" in speaking of the engine? Many other technical words taken wholly or adapted from men's names have long since ceased to be capitalized—for example, ohm, volt, ampere. Isn't it time that diesel with a little "d" is considered as a generic term rather than a man's name? What do readers think?**

## Visual Radio Direction Finder

AN article in *Aero Digest* by the inventor describes the new Dane visual radio direction finder. Radio direction finders now in use can be divided into two classes; those which can be used as homing devices and those which permit bearings to be taken during flight. The operation of the homing device is limited to airports which are equipped with transmitting facilities. The second system constitutes a more accurate system of navigation but involves rotatable loops.

For the Dane visual radio direction finder, it is claimed that absolutely automatic indication in degrees to any known radio transmitter is given, as long as the receiver is tuned in to a particular station. The loop aerials are fixed, avoiding the customary difficulties with rotatable loops.



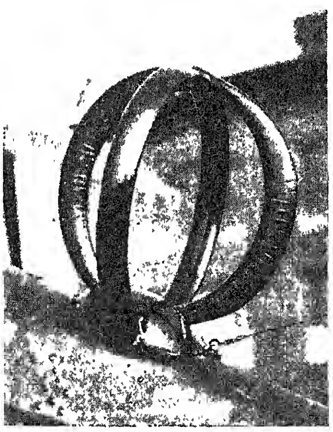
Indicating head (center) of direction finder, in place on a plane

The system consists of two electrostatically shielded fixed loops mounted at any convenient location on the airplane. The output of the receiver supplies the necessary energy for operation of the indicator. The streamlined electrostatic shielding of the loops not only assures good reception during conditions of snow or ice, but also minimizes drag. The receiver can pick up any frequency between 1500 and 250 kilocycles.

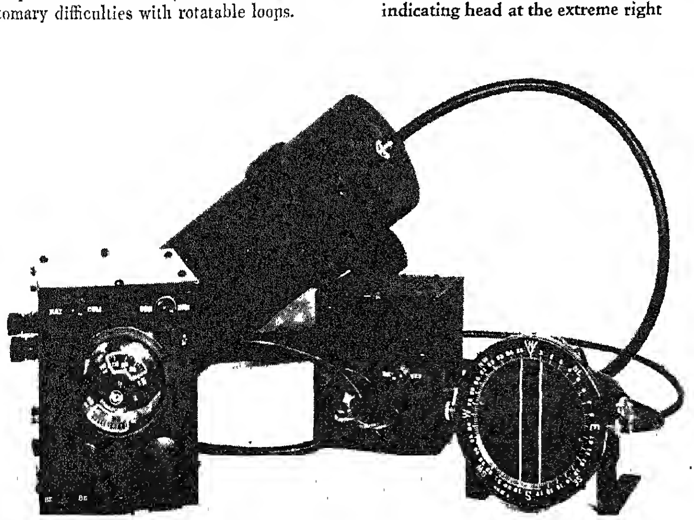
In operation, the transmitter and its direction are represented by a small spot of light on the indicating scale. By setting the outer degree scale of the indicator to correspond to either the magnetic compass or the directional gyro reading, the bearing for the transmitter is given in direct relation to either of these.

The direction finder allows homing on any suitable transmitter with the plane flying straight to the transmitter at the destination. The pilot can also, by setting on a station off the course and watching the visual indicator, know what angle the latter station is making with his course. The pilot tunes in on the check station some minutes before it is at right angles to his flight course, and watches the angle increase from say 70 degrees to 90 degrees, and then increase beyond the 90 degree value. Thus he gets a valuable check of his position. If he wishes to allow for drift, he changes the direction of his craft until the small spot of light shows 10 degrees or whatever drift is to be allowed for.

Excellent results have been obtained in service and the value of the instrument is obvious.—*A.K.*



***Above:* The fixed loops of the Dane visual radio direction finder. *Below:* The rest of the equipment, with the remote control on the left and the indicating head at the extreme right**



## Foreign Entries in Air Races

IT is common knowledge that the great success of Michel De Troyat, in a plane sponsored by the French government, was a cause of great disappointment to American contestants in recent races. A correspondent writes in to inquire whether it is fair that our racing plane builders—small groups of adventurous young men, none too well financed—should be exposed to the competition of government-supported foreign interests?

Such foreign participation does seem to be unfair, at first blush. But a race is a race, and unless our National Air Races are open to one and all, so as to provide the keenest possible competition, they will lose all interest and no longer serve to advance the art.

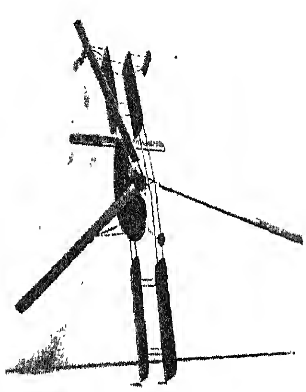
Perhaps the following is the best compromise: Let the great national events such as the Thompson Trophy Race, the Bendix

without any restrictions to all competitors. But let the smaller local races be restricted solely to home talent, with no government sponsorship allowed.

Thus we should have the advantage of world competition in the great events, yet at the same time give the "backyard" constructors a chance to pick up a few cash prizes without which they could not keep going in their exciting but precarious occupation.—*A. K.*

## The Platt Vertigiro

HAVILAND H. PLATT, an engineer of considerable ability, describes in the *Journal of the Aeronautical Sciences* a direct lift aircraft which he has termed the Vertigiro. To secure great lift for a given power, a large amount of air should be



A model of the Vertigiro

handled by the lifting air screw, and accordingly its diameter and disk area should be large. Another requirement is that the torque or turning moment of the airscrew should be counteracted. Hence, helicopters have generally been built with two airscrews rotating in opposite directions, and for the same disk area two airscrews involve very large and cumbersome overall dimensions. Another expedient has been to use two screws mounted on the same shaft, also rotating in opposite directions. Here the difficulties are loss due to interference between the two lifting propellers and where hinged or flexible blades are used it is difficult to secure proper clearances between the flexible blades.

Mr. Platt offers another solution. As indicated by the model, a single airscrew of large diameter (without excessive overall dimensions) is provided, but the reaction torque is provided by large anti-torque vanes placed in the slipstream of the airscrew. These vanes are of biplane construction with appropriate camber to provide side forces and hence a turning moment equal and opposite to that of the propeller.

Propulsion is to be obtained by tilting the rotor forward, so that the same unit contributes to both sustentation and propulsion and there is no intermediate transformation of energy.

Control is to be obtained by tilting the rotor as in the direct control Autogiro, with the anti-torque vanes providing an additional directional control in hovering.

The reduction gearing is adjacent to the rotor, and the blower-cooled engine is placed low in the fuselage with the vertical shaft ways, and three circuits for operating the typewriters. One of these circuits will be utilized for transport traffic, one for market reports issued by the Department of Agriculture, and the other will be available for experimental purposes by established aeronautical enterprises.—*A. K.*

Many ingenious ideas have been incorporated in the Vertigiro and the designer's computations and tests give evidence of high lift combined with high forward speed. It would be interesting to see these conceptions embodied in a full scale machine. —*A. K.*

## An American Simplifies the Catapult

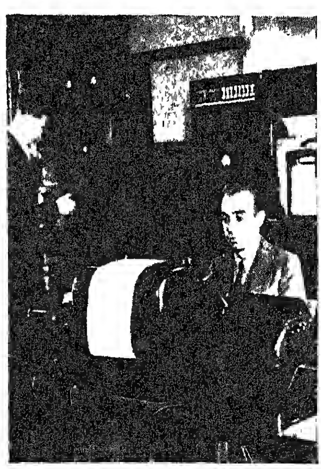
BOTH the compressed-air catapult and the gunpowder catapult are complicated affairs, but American ingenuity is likely to simplify this process of launching and give it wider use. Thus W. B. Wheatley, Chief Pilot of Consolidated Aircraft, mounted a 1700-pound, two-passenger biplane on an old railroad handcar placed on tracks that sloped somewhat downwardly. Drawn by the propeller alone, and aided by the low friction of the rolling wheels and the downward inclination, the biplane attained a speed of 60 miles an hour—far above its normal take-off speed—after a run of only 300 feet, and jumped into the air without the slightest difficulty though considerably overloaded.

Here are the advantages of this simple device: Take-offs in winter, when water is obstructed with ice and flying fields are obstructed with snow; take-offs with exceptionally heavy loads.

We would not be surprised to see many airports equipped with "catapults" of this simple variety.—*A. K.*

## Typing by Radio

DURING the past year and a half the Bureau of Air Commerce has had in operation between Washington and Baltimore a radio typewriter service. The great possibilities of operating a chain of type-



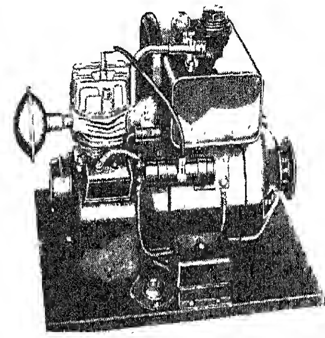
An experimental radio typewriter

writers by radio are obvious. There are appreciable savings over wired service, of course, but the great advantage is that typewriters can be operated in the airplane itself. Since safety in flying depends so much on the rapid and accurate dissemination of weather reports, and on centralized traffic control, the new system will certainly enhance safety on the airlines.

A radio typewriter system will be installed on the new airway being built between Washington and Nashville. The new installation will provide for ground-to-plane

## Portable Power Plant

TO light farmhouses, motor cruisers, summer cottages, camps, sailboats, and so forth, a portable power plant has been developed by the Continental Motors Cor-



57-pound power plant

poration, to sell at a comparatively low price. This plant, called "Tiny Tim," weighs but 57 pounds, is mounted compactly on a wooden base, and is equipped with a handle for carrying. With the battery across the line, a push of the button starts the unit and no further attention is necessary. The six-volt unit lights fourteen 15-watt electric lights and will, at the same time, charge a six-volt battery. With the tank full of gasoline, it is only necessary to start the motor and it will automatically shut itself off when the battery is fully charged.

## Belly Landings

A PILOT for Beechcraft Aircraft, Bill Ong, has made a specialty of "belly landings" in which the landing gear is retracted and the airplane lands on the bottom of the fuselage. The only accessories required for this oft repeated feat are a brake mounted on the propeller to ensure that the propeller is in a horizontal position when the belly landing is made, and two skids, nine inches high, placed below the fuselage and running from the nose to the rear landing gear struts.

With the full drag of the braked propeller and of the skids scraping over the ground the machine comes to a dead stop in a remarkably short space. Owing to the low position of the center of gravity there is not the slightest tendency to nose over.

What of it, one might be tempted to ask? There is an important implication to these experiments. If belly landings of this type are possible, then emergency dead stick landings may be made in the roughest terrain without hazard. What appears to be just a stunt may prove to be a valuable safety measure in emergencies.—*A. K.*

## Profit

THE air transport industry has often been accused of subsisting on government subsidies. We can safely say that it

of course, received payments from the government for carrying airmail, but the government has received far greater payments from the public for this service than it ever turned back to the operators. At the present time the air transport operators are carrying airmail at cheaper rates than ever before, and giving the Post Office excellent service. If they ever make profits it will be not because of payments by the Post Office but because of the larger quantities of air express matter carried, and the larger number of passengers flown. The recent report of Transcontinental and Western Air Express is most encouraging, however. There was a net income of 22.4 cents a share for the quarter ending September 1936, the largest profit ever earned by this company. The operators are not only increasing their revenues but reducing their administrative and general expenses. Much credit is due to Jack Frye, the youthful president of the young corporation.—*A.K.*

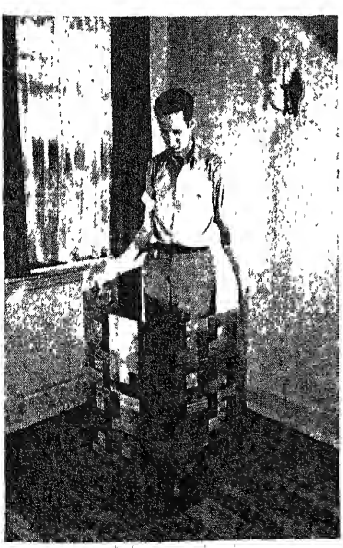
**REGISTRATION**

**MOTOR vehicle registration reached in 1936 an all-time high of 28,424,077 vehicles listed. This was nearly two million higher than the previous peak of 1930.**

## Hardwood Floors Laid Like Carpet

TODAY you can buy genuine hardwood floors in any one of a variety of woods which, delivered to your home in neat corrugated pasteboard cartons and laid in the proverbial lamb tail's shake, will last a lifetime. And these hardwood floors, Parkay by name, cost little if any more than most good-quality broadlooms—cost actually less than imitation-wood floor coverings. Prefabricated and pre-finished at the factory, they go down on any sub-floor, old or new, with neither nails nor noise and are kept down permanently by a special adhesive, time-tested in laboratories and in actual use.

Briefly, the laying operation is this: First, a layer of adhesive, then a layer of felt, another layer of adhesive, and then the hardwood floor is laid, fitted to every wall projection or indentation, perfectly finished and ready for use as soon as down. The in-between felt makes for greater quietness and a slight suggestion of resilience. Instead of the four or five days of confusion, hammering, and tedious waiting previously involved in laying hardwood floors, Parkay can be installed in the average-size room within four or five hours.



Technically speaking Parkay floors consist of individual four by two and two by

"Carpet-like" wood floor in place

two-inch hardwood blocks of standard 5/16 inch thickness, assembled in basket-weave pattern and held securely together in a semi-pliable grill. For convenience in delivery and laying, Parkay comes in cartons, each containing eight two by six-foot sections.

When buying this flooring, the customer selects the kind and shade of wood best suited to the room to be floored, from samples as easily moved about as specimen strips of carpet. Woods available are light and dark oak and walnut, and the more unusual East Indian teakwood.

## Synthetic Silk From Mulberry Trees

NOT content with processes which make rayon from cellulose, two Hungarian investigators have succeeded in making a product more closely resembling natural silk by imitating silkworms more exactly. They use mulberry bark as their raw material, dissolving undesired portions of the bark with alkali and obtaining fibers which can be spun on special machines.—*D.H.K.*

## Scratchless

THE surface of a headlight reflector is of such a delicate nature that difficulty has always been encountered in the process of polishing it. As a result, many motorists permit the surface to become tarnished or coated with very fine dust, so that the efficiency of the headlight is greatly decreased. Having this in mind, the Winchester Products Company has developed a new polish, composed of an earth pigment in a vehicle of alcohol and ether. It is claimed that if properly used this polish will not scratch the most delicate reflector surface.

In applying this polish a small piece of [illegible] and rubbed lightly but briskly over the entire surface until all tarnish is removed. A light touch is necessary, for otherwise the dirt accumulated on the cotton might scratch the reflector. Its action may be compared with that of pure castile soap, forming an emulsion with the dirt and tarnish. After the polish has dried, it is removed with a larger piece of clean, dry cotton and then the reflector is rubbed briskly with still another piece of cotton.

**12,500,000 KW.**

**HIGH current or high voltage—either one or the other is easily obtained. Fifty thousand amperes at five million volts is something to amaze. This, the highest current ever obtained at high voltage, was demonstrated recently in the laboratories of General Electric Company at Pittsfield, Massachusetts.**

## Delicate Operation with Powerful Magnet

A POWERFUL electro-magnet in the General Electric West Lynn works recently aided medical science in a delicate operation to remove seven tiny sharp needles imbedded deeply in the middle finger of the left hand of Arthur Bartlett, employee of the Atlantic Mills Company in Providence. Bartlett's finger was placed in the magnetic field, and after four hours of manipulation, five of the seven needles were taken out.

The needles lodged near the middle joint of the finger while the mill worker was operating a device used in stretching woolen

Steel needles being removed from a finger by a powerful magnetic field

cloth. The hand became infected, and it was the opinion of Dr. E. Franklin Stone, who attended Bartlett, that cutting the finger open would result in a stiffened joint. The ingenious use of the magnet possibly saved Bartlett the use of his finger.

No anesthetic was used, and Bartlett stood the ordeal without pain. Throughout the four hours, he assisted by telling how the needles seemed to be moving under the surface. General Electric engineers also constructed a small compass to aid in the determination.

Because of the minute size of the steel needle particles, it was first thought the experiment might not be successful. However, one of the needles came out less than a minute after Bartlett's finger had been placed

near the point of the magnet, the mill worker exclaimed, "It's moving! Here it comes!" A second later, a tiny piece of steel came out of the finger and attached itself to the magnet. The magnet will be used again soon in the hope of removing the two remaining needles.

This is the second time that the powerful electro-magnet has been used to aid medical science. Two years ago, it was successfully employed in removing a hypodermic needle imbedded in the hip of a Manchester, New Hampshire, doctor.

## Marsh Buggy

OF the many strange things that have had their beginnings behind the walls of the Gulf Oil Corporation's research laboratory, the oddest is, undoubtedly, the Marsh Buggy. For several months this ingenious merger of automobile, tractor, and boat has been used successfully in the transportation of geophysical crews and equipment into the seldom penetrated swamps of Louisiana.


For water, land, or both

The Marsh Buggy, acclaimed as "the unique automotive contraption of the century," rightfully cannot be classified as either a motor car, a tractor, or a boat. In reality, however, it is all three, for it is equally at home on land, in waist-deep mire, or in water deep enough to float an ocean liner.

The 7500-pound vehicle has an overall length of 22½ feet and is powered by a Ford V-8 engine equipped with an oversized cooling system. At the rear of the motor is a regular passenger car transmission coupled in series with a McCormick Deering tractor gear box.

The front wheels receive their power from chains that pass over sprockets on the back axles. This gives a differential action between the wheels on each side but not between the front and rear. The tractor transmission is provided with two brakes, one to control the wheels on the right, the other to act upon those on the left. Thus, when operated in water, the huge machine can be propelled by all four wheels or by the two on either side.

The forward axle is of conventional design with regular toe-in and caster action and the steering mechanism is similar to that of a motor car. The axle is pivoted in the center in such a manner that either front wheel can rise two feet above its mate without distorting the frame.

The tires of the Gulf Marsh Buggy were designed and fabricated by the Goodyear Tire and Rubber Company and are the largest ever molded. They are 10 feet high by approximately three feet wide and are mounted on 66-inch rims. The displacement of the balloons is so great that the monstrous vehicle floats with a "draft" of less than two feet.

If one of the tires becomes punctured, a constant pressure can be maintained by starting a compressor which feeds air into the tube. The compressor's output is sufficient to keep the balloons fully inflated until the Marsh Buggy can be returned to the base of operations where the leaky tube can be repaired or replaced. It is interesting to note that the air pressure in the tires never exceeds six pounds per square inch and that the buggy's weight is amply supported with only one pound per square inch pressure in the casings.

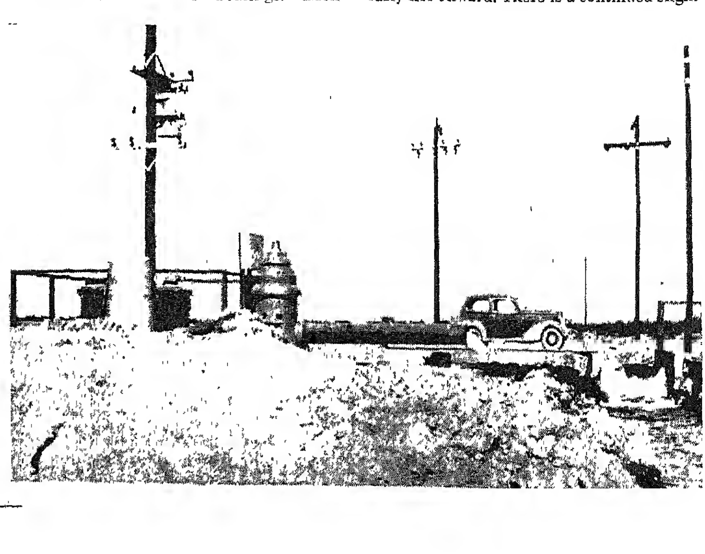
In water or in the marshes traction is obtained by attaching twelve treads to each wheel. These were made from two-inch rubber hose sealed at the ends and provided with an air valve through which they are inflated to a pressure of twenty-five pounds per square inch. Inflation is necessary to keep the links from flattening out under the weight of the monstrous vehicle.

**STERILIZATION**

**IN the 28 states which have laws providing for compulsory or voluntary sterilization of mentally deficient persons, 23,118 sterilization operations had been performed up to last November.**

## Outdoor Motors Restore Arid Acres

FIFTEEN 100-horsepower electrified irrigation pumps are converting 10,000 arid acres of the Arizona Farm Products Corporation into fertile farms suitable for raising and harvesting seven-foot high, long-staple cotton in a single season. They lift water from wells 450 feet deep and 20 inches in diameter, the water rising to within 120 feet of the surface with a total lift of approximately 140 feet. Power is supplied by the Salt River Valley Water User's Association to 100-horsepower, 440-volt, 1450 r.p.m. 25-cycle, Westinghouse, hollow-shaft, vertical motors driving vertical Pomona turbine pumps equipped with water-lubricated rubber bearings. Each pump has a capacity of 2500 gallons per minute, delivering a total of 3,600,000 gallons of water and consuming 2004 kilowatt hours per day.



Each pumping station is supplied by a simple outdoor 6600/440-volt substation consisting of three 37½ kv-a. transformers mounted on a concrete foundation, with the necessary outdoor protective devices, safety features, and lightning arresters. The substations average approximately one half mile apart and were constructed at a cost of approximately 2500 dollars each.

The majority of this tract is one large farm with electricity used for cooking and heating.

## "You've Changed Somehow"

THE ears get larger, the nose gets longer and broader, and the mouth gets wider as one grows older. The curious age changes in the dimensions of these facial organs, sufficient to change materially the appearance of the individual, have been established by Dr. Ales Hrdlicka, Curator of Physical Anthropology of the Smithsonian Institution, by measurements of thousands of men and women—white "Old Americans," Pueblo and other Indians, Eskimos, and Negroes.

When one meets an old friend after a lapse of years, there is often a vague unfamiliarity about his features which cannot easily be explained. "You've changed somehow, but I can't say just where," is a common remark. Part of the change, it is probable, is due to these altered dimensions of mouth and nose.

Among the white "Old Americans," says Dr. Hrdlicka, "both the nasal breadth and length increase during adult life with age, but the increase in breadth exceeds somewhat that in length. With the ears, conditions are reversed—they increase more in their length. Both the Pueblos and other Indians show similar conditions, and at least as pronounced. The length of the nose and the breadth of the ears increase with age but slightly; the nasal breadth, however, and the ear length increase decidedly."

The effects of age on the mouth, Dr. Hrdlicka points out, are even more marked than those on the nose. "This phenomenon is observed," he says, "in both whites and Indians, also in other races, and in both sexes. It is of a progressive nature from early life onward. There is a continued slight

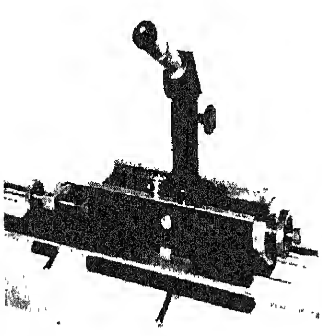
excess in the widening of the mouth through the factor of age over that of stature. Age has more influence on mouth width than has stature. It is the chief modifier of the dimension."

Generally speaking, Dr. Hrdlicka's work confirms the fact that the breadth of the nose increases from north to south, or rather from cold climate to hot climate. The effect of climate on nose dimensions is connected, according to all indications, with different demands of the function of respiration. It is in all probability the main factor which originally produced the various racial types of noses. Once these were fixed through heredity, they tended to be reproduced generation after generation, although the original habitat of the race may have changed.

## Dendroheliconometer

THERE is a growing interest in the importance of studying tree rings. A surprisingly large amount of valuable information can be obtained in this way, which is of importance in meteorology, history, and anthropology. A study of the growth rings of trees reveals information about wet and dry years, floods, and forest fires for thousands of years in the past.

The first step in this branch of the science of dendrology is to procure a sample of the wood. Where living trees are involved, special core drills have been devised, which make it possible to remove a plug having a sample of all the rings from the outside to the heart of the tree, without seriously damaging the tree.



Close-up of the adjustable microscope of the Dendroheliconometer

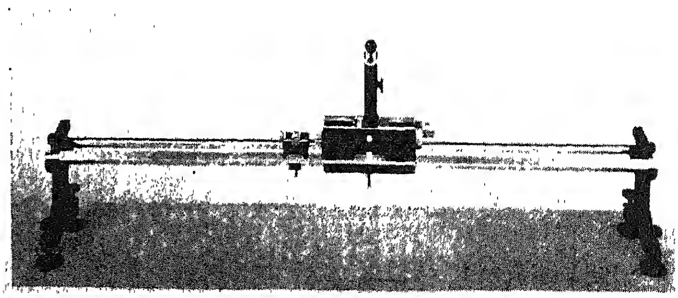
The second step is the measurement of the width of each growth ring in the tree and it is for this purpose that the Dendroheliconometer was designed.

The instrument is manufactured by the Gaertner Scientific Corporation of Chicago, and was originally designed for the Tennessee Valley Authority of Knoxville, Tennessee. It is used by the T.V.A. to determine flood years of the past with the purpose of correlating them with sun spot activity and other natural phenomena and to develop methods of flood prediction.

The Dendroheliconometer consists essentially of a microscope with fiducial cross-hairs in its field, transported by a precise micrometer screw, with a head graduated to read .01 millimeters directly and permitting easy estimation to .002 millimeters. To measure a ring, after placing the sample in the focus of the microscope, the micrometer is turned until the cross-hair of the microscope coincides with one edge of the ring. After reading the micrometer head on the screw, it is rotated to carry the microscope until the cross-hair falls on the other edge of the tree ring and the micrometer head reading taken again. The difference in these two readings gives very accurately the width of the tree ring. The microscope has a magnification variable from 5 to 40 and is equipped with a roof prism. This prism, in addition to inclining the eyepiece, produces in the microscope an upright image instead of the reversed image ordinarily seen in a microscope. This it accomplishes by reflecting the light twice internally from two faces which must make an angle of 90 degrees with each other to an accuracy of a few seconds of arc.

The micrometer screw has 100 millimeters range (about four inches) and the entire micrometer moves on guide rods having a coarse scale, which makes it possible to measure the rings on a specimen 75 centimeters long, corresponding to a tree 4½ feet in diameter, without moving the specimen.

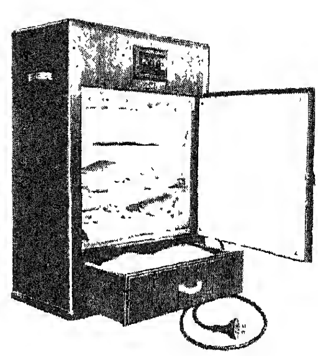
One of the interesting results of studying tree rings is the dating of woods found in ancient ruins. By studying large numbers of living trees, a master scale is made, having a given length for each year, and on this is marked a pattern indicating only unusual years—for very dry years a long mark, and for years of more rainfall, respectively shorter lines—five different lengths being used. If now a similar scale is made for any specimen of wood of unknown date and if this is placed beside the master scale, it can be slid to a position at which the two patterns match and from this position, the date at which the particular specimen of wood was cut down can be definitely and accurately determined. By overlapping of specimens, it is possible to extend the master scales back beyond the beginning of the oldest known living tree, and some scales are now available complete to before the time of Christ.



## For Babies Only

NAMED to indicate its application of a new principle and use, the new Desertaire all-electric infant's apparel wardrobe-cabinet makes its bow to young mothers and their babies.

Called the "first electric home appliance for babies," Desertaire cabinets are designed to sterilize, heat, and thoroughly dry, and maintain in a dry and heated condition, all of an infant's wearing apparel 24 hours a day. The maintenance of an infant's diapers and other articles of clothing, including minor bedding accessories, such as sheets and cover blankets, in a sterile, electrically-dried and heated, body temperature condition, is, of course, important from the health standpoint.



Insuring warm, dry clothes for baby

The cabinets, which are finished in walnut as articles of beauty as well as utility, come in two sizes: one, a semi-portable design, suitable for easy removal from room to room or for traveling; the other, a larger size, for nursery use, may also be moved about the home because of rubber-tired wheels. Both incorporate the same features of white metal, steel-shelved interior compartments in which baby's clothes are stacked. Cabinets are equipped with "high" and "low" selector switches, night lights, and in the case of the larger model, with a special electric circulating heater which may be turned on to heat the immediate surroundings while baby is being bathed or changed and which may also be used to take the chill from the room.

### SUNDAY EDITION

**A SINGLE issue of a large daily metropolitan paper uses more paper than was used in the whole United States in 1800. The Sunday edition requires the product of 240 acres of pulpwood forests.**

## Protecting Metal Before Painting

CLEANING iron or steel before painting produces a surface which rusts more easily than the uncleaned metal. To provide extra protection, several processes are widely used to protect the metal with rust-resisting coatings to which paint will readily adhere. One of these, forming a dark red coating of iron phosphate on the metal, can be applied by either dipping or spraying. Another employs an aqueous solution of chromic acid with an activating agent to change the character of the metal surface.

Still another applies a continuous coating of zinc phosphate to the metal by means of an alternating electric current. These processes are standard practice in preparing for painting the metal used in the automobile and refrigerator industries. Their adoption in other industries is increasing since they give longer life to the paint film and better protection for the metal.—*D.H.K.*

## Mechanical Calculation Moves On

SIX answers at the same time, silence, and the ability to handle anything of a repetitive nature up to and including algebraic computations—these are the features of a device based on an entirely new principle in the development of mechanical calculators.

Designed jointly by LeRoi E. Hutchings, the originator of a number of well-known

Six answers at the same time . . .

business devices, and Herbert Austin Brown, the new calculator operates by means of a sliding panel which spots the proper answers from among an array of predetermined calculations in the interior of the machine, which is called the Costometer.

Since most of the actual calculation goes into the preparation of the tables, the keys, cogs, and wheels of the conventional type of machine are eliminated and there is no necessity for mechanical computation of each mathematical step in a problem. The device shortcuts its way directly to the proper solution and may reduce the number of individual manipulations by as much as 99 percent.

The originators state that the device is not intended for use as an all-purpose machine, but is designed to handle calculations of the repetitive type required in the figuring of job cost, payroll, interest and discount, and similar work. An increasing volume of these types of data is becoming necessary in every class of business, the new Social Security laws alone requiring a complete set of reports and figures on some 27,000,000 employees throughout the country.

The multiple-answer feature of the new device will permit the simultaneous solving of Federal and State Old Age Benefit, Federal and State Unemployment taxes, total weekly wage and net wage after deductions, a total of six calculations at the same time. The tabulations in the interior of the machine are specially prepared and arranged to fit the individual needs of the of tabulations can be brought into position under the index panel at the will of the operator.

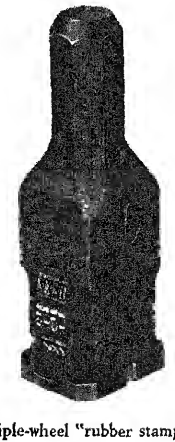
The pre-determination and arrangement of tables permit the handling of any type of calculation, including combinations of addition or subtraction with multiplication and division, or the solving of complicated algebraic formulas where an extended series of solutions hinges on one or two variables.

**MARCHING TREES**

**THIRTY million years ago the redwoods that are now the pride of California had relatives in Greenland, Siberia, and other northern lands now much too cold for them. Obviously, they marched southward and westward as the glacial ages froze the northern countries.**

## A "Rubber Stamp" for Metals

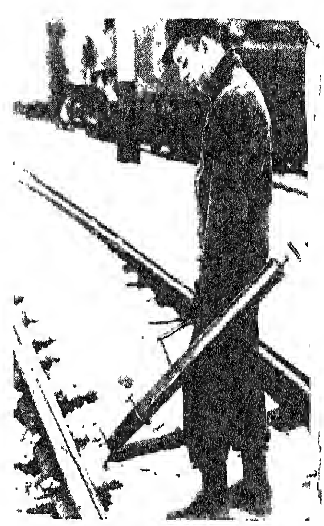
AN accompanying illustration shows a new multiple-wheel metal marking machine which has been developed by the Quality Die Company. This may be made with figures of sizes varying from 1/16 to 3/8 of an inch, and with from four to eight wheels. Indicators are provided to locate position of marking. Impressions are made by hammer blow. Changing of serial readings is done by hand, one wheel being turned at a time while the other wheels remain locked; and all wheels remain locked after a serial is selected. Letters and figures will stand up on any material up to 415 Brinell hardness.



Multiple-wheel "rubber stamp" for metals, to be used with a hammer

## To Thaw Switches, Burn Weeds

DESIGNED to thaw frozen switches, start back fires, or burn weeds, a new type of utility blow torch has been developed by the Turner Brass Works. The blow torch may be carried easily in one hand while a hot blue flame is shot downward at the ground. The torch was originally designed through the co-operation of the back fires and burning weeds. Many varied uses for the torch have been found by railroad companies, park departments, public utilities, highway departments, farmers, and poultry men.



Portable utility blow torch being used to thaw out a railroad switch

Fighting fire with fire, or back-firing, may be done effectively in less time with the new torch, it is said. Damp rubbish piles may be dried and burned quickly, and noxious weeds and undergrowth along railroad rights-of-way or highways destroyed. Because of the intense heat of the torch, it is said to be ideally adapted to thawing railroad switches in a quicker and more satisfactory way than by other methods. The torch may also be used for fumigating buildings constructed of fire-resisting materials, as flame in many situations is more effective than disinfectant solutions.

The torch is equipped with a coil burner of the firepot type which develops a wide-spreading, intensely hot blue flame. The burner is protected by a sheet metal shield. The tank is made of heavy seamless brass tubing with cast bronze ends brazed into place. It is equipped with an adjustable handle that can be folded flat when the torch is being transported. A quick-action pump serves as a filler plug. The torch will burn 2½ hours on one filling of gasoline, the tank having a capacity of ¾ gallon. Overall length is 41 inches, diameter is three inches, and shipping weight 14 pounds.

## Fact, or Fiction?

FAR be it from the editors of this magazine to state that the item quoted below is true or untrue—you may believe it or not. It is from *Nature* (London) and *Nature* quotes it from the *Medico-Chirurgical Review* of 100 years ago—October 1836; and this, in turn, had quoted it from the French press by which the incident was stated to have taken place at Aunay in the Department of Avalon:

"A very fat woman, aged 74 years, addicted to drinking brandy, lived alone, and one evening returned home as usual, but, as she did not appear among her neighbours the next morning, they knocked at her door. No answer being returned to repeated de-

forced the door and exposed a horrible spectacle, accompanied by an extraordinary smell.

"Near the chimney lay a heap of something burnt to cinders, at the end of which was a head, a neck, the upper part of a body, and one arm. At the other end were some of the lower parts, and one leg still retaining a very clean shoe and stocking. No other traces of fire were to be seen, except a blue flame which played along the surface of a long train of grease, or serous liquor, which had been produced by combustion of the body.

"The mayor found it impossible to extinguish this flame, and summoned all the authorities; and, from the state of the apartment and comparison of circumstances, it was concluded among them that previous to going to bed, for which she had evidently been making preparations, the woman had been trying to ignite some embers with her breath. The fire communicating with the body by means of the breath, combustion probably took place."

While ignition and combustion of a body seems quite possible (arctic birds, very oily, are combustible—human "grease balls," touched off with the alcohol that is eliminated via the breath may be similarly so), we have no record that such a thing has frequently happened. It would seem that, with many very fatty alcoholics still existent, similar instances would occasionally happen, even today.

### MATHEMATICIAN

**DAYS of laborious computation by trained mathematicians are no longer necessary at M. I. T., for a new one-ton machine with many complicated levers and gears will, in a single action, solve nine simultaneous equations with nine unknowns.**

## Rare Elements Improve Alloys

COLUMBIUM, one of the relatively rare elements, can be used in small amounts to improve the resistance of stainless steel to corrosion at high temperatures (500 to 800 degrees, Centigrade). Titanium, still considered to be a rare metal although it actually ranks ninth in order among the elements that form the crust of the earth, is similarly effective. At high temperatures, stainless steel, even with a very low carbon content, has a tendency to form a carbide precipitate between the crystal grains of the metal. At these points corrosion begins. The addition of tiny amounts of columbium or titanium apparently prevents this segregation.—*D. H. K.*

## Steam-Electric Locomotive

ANOTHER page in the rapidly accelerated history of modern railroading will be turned early this year with the appearance on the Erie, Pennsylvania, test tracks of the General Electric Company of a new steam-electric locomotive which is being built for the Union Pacific Railroad.

This new passenger unit will carry a

feeding electric power to traction motors. Radically different in design from any locomotive now in service—of either steam or electric type—it will eliminate two of the colorful characteristics of the steam-railroading days: the side-rod drive and the water tower. Electric power will drive traction motors constructed on the usual electric locomotive design, and the turbine will operate condensers using the same water over and over, with small additions to make up for leakage. The problem of picking up water is thus largely done away with, and clean distilled water will insure long life and permit long runs without boiler repairs.

The many desirable constructional features of the modern high-speed electric locomotive will be incorporated in the design. Because of fundamental differences it is expected that the new locomotive will show a tremendous reduction in fuel consumption and a correspondingly low maintenance.

The new unit will be a double-cab locomotive, rated at 5000 horsepower. The two cabs can be operated together in the same manner as with electric locomotives. It will haul 1000-ton trains such as the Union-Pacific *Challenger* or the *Los Angeles Limited* over the Los Angeles-Omaha route.

Streamlined, practically smokeless, and provided with equipment for air conditioning, the new locomotive will be modern in every respect. The builders promise speeds of 110 miles per hour on level track. Sufficient fuel oil for a long journey will be carried be greatly reduced. Because of this greater availability, an increased mileage per year is expected to develop.

As with the electric locomotive, a finely graduated scheme of control will permit smooth and easy handling, rapid acceleration, and effective braking.

A new, highly efficient type of steam boiler has been built, and tests give ample assurance of power to meet the exacting requirements of the locomotive. The high steam pressure and use of condensers are in line with the latest practice in modern power plant construction.

The boiler will use fuel oil similar to that employed by other locomotives on railroads today, but the method of combustion will be more accurately controlled to obtain the maximum amount of power from a given quantity of fuel. The almost perfect combustion will insure practically smokeless operation.

## Mixtures As Anti-Freezes

SHORTAGES this winter of some of the better known anti-freezes used in automobiles lend particular interest to the possibility of using mixtures instead of pure materials. An unexpectedly large demand for ethylene glycol and a shortage of glycerol, presumably caused by use in synthetic resins of large quantities of this by-product of soap making, have created a scarcity of both of these valuable materials. In a recently completed study at ing points of mixtures of glycerol with methanol and water have been determined and the way shown to overcome both the scarcity of glycerol, which does not boil away, and the evaporation of methanol from the radiator. Using a mixture of equal parts by weight of methanol and glycerol and blending this mixture with water, protection against freezing is obtained as shown in the following table:

| Percent by weight of methanol-glycerol mixture in water | Freezing point, degrees Fahrenheit |
|---|---|
| 10% | +25° |
| 20% | +14° |
| 30% | — 1° |
| 40% | —20° |
| 50% | —45° |

In such a mixture the rate of evaporation of methanol is materially reduced and the effectiveness of the glycerol is increased. The proportions given here are by *weight* and not by *volume.*—*D.H.K.*

## Research on Tire Chains

AN Industrial Fellowship that is investigating broadly the durability of automotive tire chains has been founded at Mellon Institute of Industrial Research by The McKay Company of Pittsburgh, Pennsylvania, which manufactures commercial chains of all types. This Fellowship, which began operation on September 15, 1936, has for its objective the production of better chains, particularly for the motorist. A comprehensive program of basic research is being carried on, including studies of the design, materials, processes of manufacture, and testing of chains.

## Chromium and Its Alloys

TODAY, according to W. J. Priestley of the Electro Metallurgical Company, we have many different commercial grades of so-called "corrosion resisting" and "rustless" or "stainless" steels containing from 1 to 35 percent chromium. A list of the elements that are used for modifying the properties of straight chromium steels include nickel, silicon, manganese, molybdenum, copper, tungsten, columbium, titanium nitrogen, aluminum, sulfur, selenium, zirconium, and vanadium.

Steels containing up to 3.5 percent chromium are known as "mild alloy steels" and their use was developed to replace simple carbon steels because of their greater strength and resistance to atmospheric corrosion. Among steels containing 3.5 to 9 percent chromium are the well known 4 to 6 percent chromium steels which were originally developed as a compromise in quality and cost between the higher chromium stainless steels and plain carbon steel. They are finding general use in the petroleum refining industry where good service is obtained in oil still tubes.

With carbon under 0.12 percent and chromium raised to 16 to 20 percent, we have a steel which possesses excellent corrosion and oxidation resistance without special heat treatment. The addition of 1 or 2 percent of nickel hardens and raises the strength of this steel when heat treated, making it suitable for aircraft construction.

When chromium is increased to over 20 percent we have an alloy that offers good resistance to oxidation up to 2000 degrees,

this grade of steel to retard grain growth when it is held for a long time at high temperatures. For ordinary use, nitrogen will reduce the grain size and make the metal more shock resisting.

A new alloy has been developed which contains 35 percent chromium and 7 percent aluminum which is good for continuous service at 2300 degrees, Fahrenheit.

The group of 17 to 20 percent chromium and 7 to 10 percent nickel steels represent the best known and most widely used stainless and corrosion-resistant steels. Their popularity is due to their ease of fabrication and good physical properties at high and low temperatures, combined with their excellent resistance to oxidation at high temperatures and with many different kinds of corroding media.

They cannot be hardened by heat treatment, but, by cold working, their ultimate strength can be raised to over 200,000 pounds per square inch with suitable ductility, which makes them satisfactory for light-weight structures requiring great strength, such as aircraft, superstructure of ships, and high speed trains.

Alloys containing from 13 to 20 percent chromium and 60 to 80 percent nickel are used in the food and dairy industries. They have good resistance to oxidation up to 2000 degrees, Fahrenheit, and are also used for electrical resistor material for high-temperature service. It has been demonstrated that the addition of chromium to nickel makes it free from tarnishing and corrosion under the very conditions for which nickel itself is unsuited.

### DONKEY MILK

ACCORDING to an Indian scientific journal, donkey's milk is one and a half times as digestible as the milk of cows. It is therefore used in many countries for feeding children and invalids.

## Preserve Nut Meats By Hot Water

A NEW home method for keeping nut meats fresh—using a water bath canner such as many housewives use to process fruits—is announced by the United States Department of Agriculture.

Many families who make a winter industry of preparing shelled nuts for sale or home use, often take a loss when warm weather causes the oil in the nuts to become rancid. Commercial concerns avoid this staleness or rancidity, caused by light and heat in combination with air, by vacuum-packing the nut meats.

The only equipment needed for vacuum-packing nut meats at home, says R. C. Wright, of the Bureau of Plant Industry, who developed the method, is glass fruit jars to hold the nuts and the water bath canner to exhaust the air from the jars. He says:

"Fill glass jars with nut meats and adjust the glass lids and rubbers but do not tighten them. Set the jars in a water bath canner—either a clothes boiler or a big kettle with a rack on the bottom. Use enough water to reach almost to the top of the jars. Keep the water boiling

# THE AMATEUR TELESCOPE MAKER

Conducted by **ALBERT G. INGALLS**

SUPPLEMENTARY, in a way, to the long article by Captain C. S. McDowell in the *November number*, describing the 200" telescope plans, are the new drawings, Figures 1 and 2, made by Russell W. Porter and kindly furnished for this department by Captain McDowell. Figure 1 shows the oil pads, but Figure 2 is probably the more interesting. In his article Captain McDowell described the declination axis as follows: "The declination axis of the telescope is formed by two trunnions mounted on ball bearings in the 10' 6" diameter tubular yoke girders and conneeted to the tube by means of flexible spoke gimbals. Flexibility of connection between the yoke and the tube is required in order to avoid imposing strains on the tube due to slight inaccuracies in mounting that may occur during assembly and due to deflection of parts. The gimbals on either side of the tube consist of two alloy steel flanges, one attached to the declination axis trunnion and the other to the tube, joined by 144 three-fourths inch diameter spokes. These spokes are so arranged that their extensions intersect at one point on the declination axis, thus forming a fulcrum. The gimbal spokes permit slight rotation of the tube about these fulcrums, at the same time restraining it against any other motions. There are six additional spokes connecting the gimbal flanges, arranged in a plane perpendicular to the declination axis, to resist the torque required to drive the tube in declination."

Some readers experienced difficulty in visualizing the plan from a verbal description, such as just given, hence the drawing in Figure 2 was made. You are looking at the hollow declination axis in the center, which extends to the left from the large framework of the tube (on the right); and at the left you are gazing down the deep well afforded by the interior of one of the two big yokes: couder mirror is at the right, diagonal and an astronomer at left—and the bird cage made by the spokes is near the center. It hardly seems possible that any one will adequately grasp the hugeness of this telescope until he has actually climbed on, in and over it a few times; it is like trying to imagine a billion dollars (or, for most amateurs, a mere million! Or why stop there?).

HAVE you a wife? If so, is she a "Telescope Widow"? No doubt she is. No doubt you often become absorbed in practical or theoretical optics and forget to come to your meals, go to bed or perhaps, thinking of ways to solve problems of obstinate mirrors, you start to change your clothes for a meal and find you have undressed and got into bed at 6 P.M., as this writer once did. Telescope Widow Number One lives in has a sense of humor. She used to live in Vermont, and while there she coined that accurately descriptive term for the lot of us, abbreviated as "T.N.," meaning "Telescope Nut." 'Tis said that the clock building amateurs call themselves "Clock Maniacs," and in aviation certain enthusiasts for the

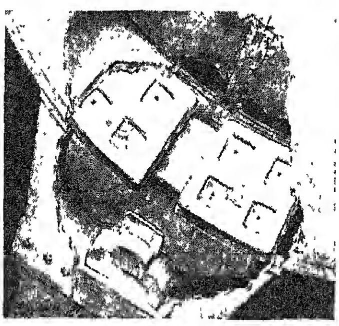
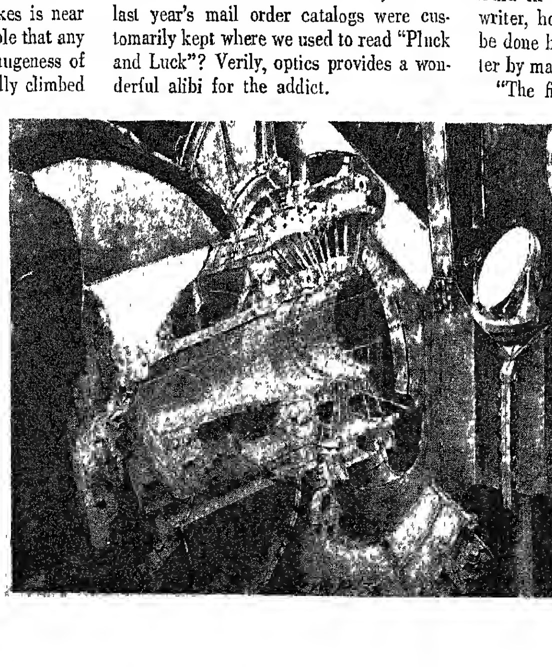


*Figure 1:* **Oil pad for the 200"**

lighter-than-air kind are known as "Balloonatics." Well—anyway—here is an item from the *Pasadena Post*, describing the flower show of the Pasadena Flower Show Association, which "T.W." No. 1 sent to us; show it to your wife if you own one—she will understand. "For awhile yesterday Association officials had a mystery," the clipping runs. "A woman at the gate requested they inquire at the police station if her husband had been injured in an automobile accident. He had gone to park the car and she had waited an hour and a half for him. Inquiry failed to disclose the whereabouts of her husband, Russell W. Porter. She decided to wait another half hour. At the expiration of this period, Mrs. Porter went looking for the car and discovered him in it, reading a book, having forgotten about the flower show."

The only mystery now remaining is the title of that book. Was it Conrady's optics, "A.T.M.," or one of those old "Pluck and Luck's" we used to read in the days before last year's mail order catalogs were customarily kept where we used to read "Pluck and Luck"? Verily, optics provides a wonderful alibi for the addict.



CORNING is now making 20" Pyrex disks of two kinds—solid ones and 20" replicas of the 200" disk, the latter naturally costing more than the former (harder to make). A number of amateurs have indicated their hopes of obtaining disks of this size; we know of one, for example, whose wife, by the time you read this, will have given him one for Christmas (wives please note). It is no longer correct form to raise the eyebrows more than part way when a telescope maker tackles a job of that size; in fact, who dares set the limit for the amateur? There is some added odor of romance or glamor surrounding the ribbed or non-solid disks, since they are copies of the big 200" disk, and there would be even more odor thereof if some amateur would go the whole hawg and build a tenth-scale replica of the 200" telescope, mounting and everything. So far as we know, nobody has yet started to do this.

C. R. TINSLEY, 3017 Wheeler Street, Berkeley, California, has been working one of the 20" replicas of the 200"—ribbed type—and here is his account of the job:

"To us, Mr. O. A. Gage of the Corning Glass Works had written: 'Your disk is the first one that has been made and sold commercially.' It was a proud day for us and our staff as we gathered around the packing case and the beautiful thing was exposed to view—a perfect 20" replica of the great 200" disk now being ground at Pasadena. With its pearly, alabaster, semi-translucent ribs, it looked for all the world like a gigantic wedding cake (Figure 3).

"The virgin disk had a 3½" hole through the center and, due to its having been cast in a ceramic mold, had a slightly pebbled, frosty surface. The working surface increased in thickness toward the center in such a way that the concave, finished face should be of equal thickness throughout. The glass weighed 45 pounds and it would have been entirely feasible to grind and polish it by hand in the usual amateur manner. The writer, however, believes that nothing can be done by hand which cannot be done better by machinery (yes, even parabolizing!).

"The first job was to grind both faces flat. This was done on a revolving, cast iron turntable (Figure 4), 24" in diameter and run at 300 r.p.m. This apparatus is driven by a ⅓ H.P. motor. The disk was laid on the table between guides which held it somewhat off center. A location was found in which the mirror automatically revolved as the turntable passed under it, and we could stand back and enjoy the job. No. 80 Crystolon was used, and the time consumed was about two hours. The back was finished with No. 240 Alundum. The machine which was to be used for grinding and polishing required that the disk be ground truly circular and have

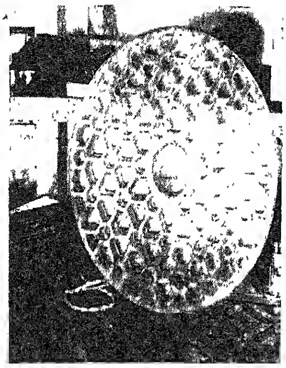


*Figure 3:* Tenth-scale replica

complished by fitting a wooden plug in the central hole (Figure 4), through which a shaft was fitted and the whole mounted on edge on crude bearings above the turntable. Arrangements were made to lower it gradually as the edging proceeded. Again No. 80 did the job; followed fine grinding with No. 240. Time, about 1 hour.

"The machine (Figure 5) used for grinding and polishing has been a development of several years' experience. There is no mechanism for revolving the mirror, other than the drag of the turntable below. All motions of the machine are adjustable as to speed and the table, in this case, was set at 1.5 r.p.m. The mirror sets freely on the table and is pushed first from one side and then from the other. For the present job this was done at 20 stroke cycles per minute. The pushers are low down near the working surface and, unless weights are used, there is no force that could affect the shape of the glass other than gravity. During the pushing movements, the mirror does not revolve with the table but at the change of direction there is a momentary freedom of movement, at which time the mirror revolves by about ¼" of its circumference. The pushers are hinged so that they follow the glass as it assumes a rocking motion on the convex tool. The motion is imparted to the pushers through an upright walking-beam leading to the mechanism below. The motor used is ⅓ HP (¼ HP for smaller glasses). The pulleys and belts are V type. Length of stroke is governed through an adjustable crank.

"The tool used was 1¼" plate glass and the abrasive, during rough grinding, was fed through the hole in the mirror. Except to note progress, it was unnecessary to remove the mirror from the tool at any time. No. 36 Crystolon was used and, as the glass sludge accumulated, an overdose of water caused perfect purging *without washing out the abrasive.* Pyrex, ground on plate glass, *practically never grabs,* though we used care not to let the abrasive become too thin. The face thickness, though ample, was not sufficient to permit wearing away any of the edge. We were therefore compelled to use long strokes and hog out the center first, spreading the curvature toward the edge later with shorter strokes.

"Just before rough grinding was finished, a 3½" disk was cut from a 4¼" Pyrex port hole and this disk was ground to approximately the same concavity as the mirror. The tool was cleaned and oiled (to prevent plaster from sticking) and, with the mirror and plug resting on the tool, plaster of

cided. Thereafter it was necessary to lift the mirror when new abrasive was applied.

"When the focal length seemed correct, the whole was brought to a sphere by using 30 pounds of extra weight on top of the mirror. This brings up a matter which is understood by too few. Concaving action is a function of *gravity alone,* while extra weight merely causes more wear *equally distributed* over the entire surface. While a one-third stroke will theoretically produce

*Figure 4:* Edging the 20″ disk

a sphere, weight alone will do a better job. If the weight is large, in proportion to the tipping due to gravity, the glass will come to a sphere almost regardless of length of stroke. Unfortunately, this principle cannot be applied so readily to a plastic polishing tool, but for solids it works perfectly.

"The grinding had consumed 102 hours, *including time out for measurements,* adjustments, etc. The fine grinding, including the 600, had all been done with *thirty* pounds' extra weight on top of the glass. We believe it due to the use of this weight that on the first Ronchi test, at the end of 500 strokes, the entire mirror gave a bright reflection, and at no time was it possible to say that any part was polishing faster than another. Nor was the mirror ever out of control from start to finish, the final parabolization being the farthest departure from the sphere.

"We anticipated considerable difficulty in forming our pitch tool, and probably would not have been disappointed had we followed established procedure. The total concavity was 5/16″ and the sides of the tool were as steep as a toboggan slide. We are always ready to try anything at least once and so on this occasion we indulged in radicalism de luxe. The tool was turned bottom side up, with its flat surface exposed, and carefully leveled. A paper fence was tied around it in the usual manner. Then the surface of the tool and the paper fence were liberally smeared with glycerine. In melting the pitch for the tool, care was taken to pour while yet a small solid remained unmelted. This insured the pitch being near the solidifying temperature. When we were ready to pour, it was noticed that surface tension had caused the glycerine to recede from several spots on the tool, leaving its surface dry. A few strokes with the finger cured this and the pitch was poured at once. As soon as the 3/16″ sheet could hold its shape at the edge, the paper fence was removed and a long spatula carefully slipped around between the soft pitch and the flat tool face.

broad, flat board and the tool turned face up after wiping off the glycerine. The tool was then applied face down to the top side of the pitch slab but not allowed to press. The whole combination was then turned right side up and the board removed. The pitch slab at once settled down on the tool and was wiped free from glycerine on its top side. The HCF was laid on top, the rouged mirror was added, 150 pounds' weight was applied over all and, in exactly one hour from the start of operations, polishing began.

"It will be objected that in the two transfers of the pitch distortions in thickness were bound to be set up; also that adding 5/16″ to the top of the tool would offer a different radius of curvature than that of the tool or mirror. The only answer I can make is that, in practice, the darned thing worked perfectly. I have since made a 9″ lap by the same method and shall probably use it exclusively in future.

"Pressing presented some problems. The tool, originally 1¼″ plate, was now barely ⅞″ thick and found subject to flexure; hence no cold pressing could be used. Upon heating the tool, the curvature was so steep that the pitch sagged in the middle and formed a flat top before pressure could be applied. Finally, the HCF was stripped off and the mirror smeared with turpentine. The mirror was then worked on the bare pitch, as in grinding, the turps being wiped off and renewed as fast as it began to become tacky. When the pitch exactly fitted the mirror at all points, new HCF was applied, and the results exceeded any previous experience in pressing. This process was used three times during polishing operations. At no time during the job did the curvature depart from the sphere by an amount nearly so great as the final parabolization. The HCF was never scarified but hosed clean from time to time. Scarification merely prevents the rouge from collecting

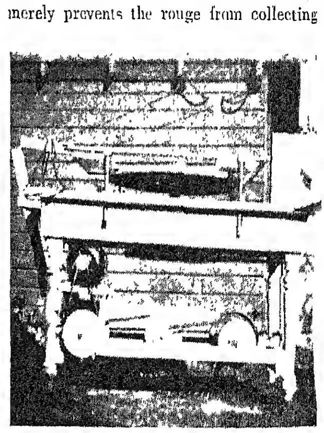


*Figure 5:* The machine

at undesirable points and, if the lap is cleaned frequently, is not needed.

"I would like to offer a word about turned down edge. Since learning the importance of keeping the edge of the polisher wet, we have scarcely seen such a thing. We believe that 95 percent of all turned down edges—at least, those not inherited from fine grinding—are caused by dry-edged polishers. Consider for a moment that *all* polishing operations tend gradually to deepen the center of the curve. A dry edge of polisher absolutely ceases to polish. The re-

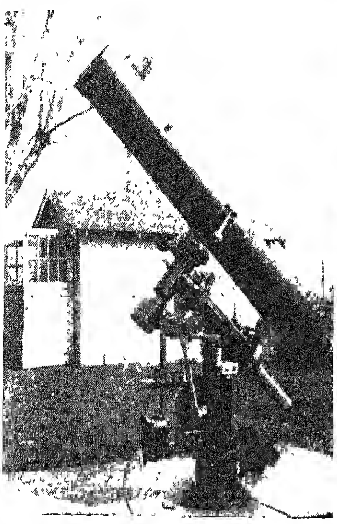


*Figure 6:* A sturdy and rugged mounting, made by James E. Myers, 1519 Olin Avenue, Omaha, Nebraska. The drive is of special interest (the extra "shaft" is only a pipe in the fence in the rear)

wet continues to deepen the mirror, while the dry edge of the glass does not change its curvature. This leaves a shelf at the edge of the mirror, which is turned down with reference to the deeper center. This does not apply to the outer 1/32". That same slight amount appears at the edge of a Cassegrain plug and is not worth considering. Finish your mirror with as little bevel as possible, and bevel it 1/32" when done. Our replica will have 20½" clear aperture after such beveling operation.

"Parabolization was effected by trimming out the standard rose tool and continuing the machine operation at ⅓ stroke. Results could not be improved by hand.

"Total time for polishing, 73 hours; for parabolization, 3 hours."

WHY isn't the present an auspicious time to start planning to make a spectroheliscope? The sun is now about half way between a maximum and minimum of sunspot and other activity. In two or three years this activity will be very great, and by 1939 or 1940 will be at a maximum—the more active of the pairs of maxima.

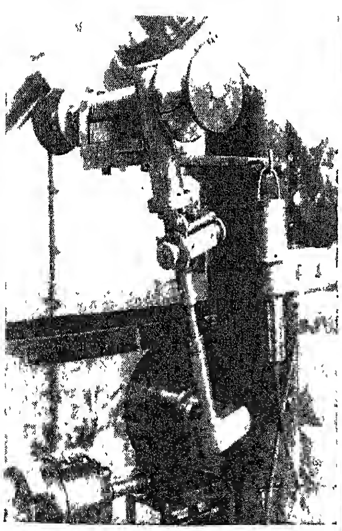
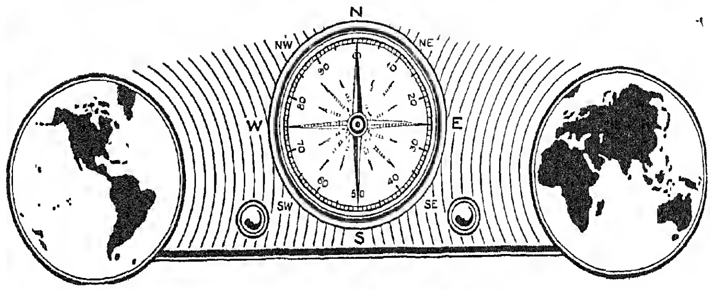


*Figure 7:* A close-up view of the




# WORLD-WIDE RADIO

**Conducted by M. L. MUHLEMAN**
Editor, *All-Wave Radio*

## Weak-Signal Reception

MOST modern receivers are equipped with automatic volume control for the purpose of maintaining a relatively constant volume output on all stations and to equalize fading signals. Since the basis of the control action rests in reducing the radio-frequency gain or amplification of the receiver as signals increase in strength, it is obvious that, with no other provisions, any signal will automatically tend to reduce the overall sensitivity of the receiver.

Under such conditions the owner is deprived of the use of a certain degree of sensitivity the receiver would otherwise have. And it is this "last ounce" of sensitivity that is often required to bring a weak signal up to a point where it is distinguishable.

This drawback is eliminated in some receivers by the use of a delayed automatic volume control action. Circuit values are so adjusted that the automatic volume control does not function unless the received signal is above a predetermined level. The radio-frequency amplifiers in the set therefore run "wide open" if the signal is weak; thus no sensitivity is sacrificed.

But the fact remains that many receivers do not have delayed automatic volume control. In some sets the loss in sensitivity may be quite small, but in other sets the inherent amplification may be reduced to such an extent that the receiver is incapable of picking up weak signals.

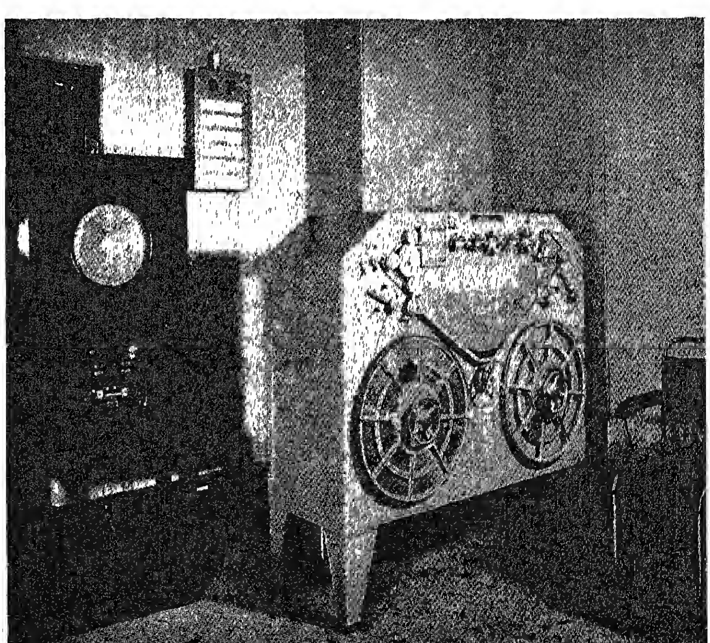
This fault may be removed by installing a simple toggle switch that will cut out the automatic volume control action while hunting for distant stations. Control action can be immediately restored by flipping the switch in the opposite direction.

The installation of such a switch is not a complicated procedure. Any radio service man can do the job in short order.

## British Recording

THE G-string short-wave stations of the British Broadcasting Corporation are equipped to make instantaneous recordings, in "newsreel" fashion, of special events of import to the Empire. This is something as yet untried in this country, although we accomplish much the same result through "pick-up" broadcasting.

The BBC employs Marconi-Stille Recording Machines, one of which is shown in the accompanying illustration. The programs or special events are recorded magnetically on a steel tape which winds off one reel and on to another. When the tape is "played back," the magnetic variations in the tape produce minute electrical currents in a pick-up coil. These currents are amplified and passed on to the broadcast transmitter.



Courtesy British Broadcasting Company

Such recordings are not permanent, but are retained in the tape for a number of hours. When the recording is no longer of service, it is "wiped off" the tape by an electro-magnetic process. The tape may then be used for other recordings.

### NEW VENEZUELAN STATION

PERMISSION has been granted by the Venezuelan Ministry of Communications to Nicolas Vale Quintero, of Maracaibo, Venezuela, to establish and operate a commercial radio broadcasting station in that city.

The new station will be situated five kilometers from the center of the city, and will operate with a power of 250 watts, on a frequency of 1120 kilocycles (standard broadcast band) and 6350 kilocycles (49-meter short-wave broadcast band). The call letters will be YV1RG and YV1RH for long and short wave respectively.

### FOREIGN AMATEUR PHONES

ALTHOUGH the 20-meter (14 megacycle) amateur radiophone band is excellent for long-distance communication throughout the year, it is of particular interest to the short-wave listener at this time.

East Indian and Australian stations may be heard in the early mornings; between 8 P.M. and midnight, depending on the length of time the band stays "open," stations in South America, South Africa, and the Hawaiian Islands come through with fairly good strength.

Foreign stations, other than those located in U. S. Possessions, operate outside of the American amateur radiophone band; that is, just below 14.15 megacycles and just above 14.25 megacycles. The majority of the Hawaiian stations operate close to the high-frequency edge of the band, or 14.25 megacycles.

These foreign stations are audible for only short periods of time and usually fade into the background in less than an hour. The trick, then, is to listen at the proper times. At present the Hawaiians are coming through between 10 and 11 P.M., but as winter progresses they will be heard earlier in the evening.

By far the easiest method of locating such stations is to "pace" the amateurs in the American phone band. These fellows work with their ears wide open and they are experienced in spotting foreign stations. When you hear them calling such a station, pick up the letters and then tune to the high or the low side of the band. As likely as not you'll be successful in picking up the foreign station as readily as the American amateur.

### U. S. SHORT-WAVE BROADCASTERS

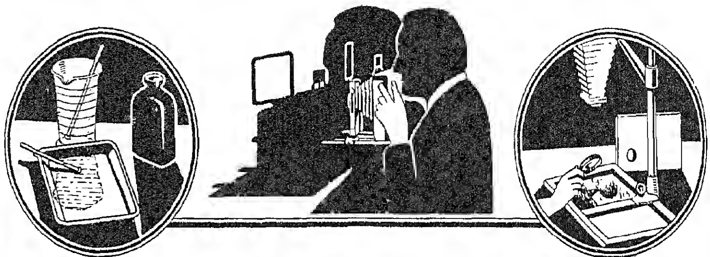
THE recent Federal Communications Commission regulations with regard to the power and frequency stability of American short-wave broadcast stations has resulted in the closing down of some transmitters. The stations remaining are on regular schedules and are worth your attention. The international programs, not heard on the standard band chain stations, are particularly interesting.

A list of the principal U. S. short-wave broadcast stations, compiled by the Radio Manufacturers Association, is included in this month's column. The schedules and frequencies are complete and up-to-date.

### SCHEDULE OF PRINCIPAL U. S. SHORT-WAVE STATIONS

*In Eastern Standard Time*

| | | | KCS | M |
|---|---|---|---|---|
| W1XK (NBC) Boston | Daily | 6:30 a.m.- 1:00 a.m. | 9,570 | 31.3 |
| | Sundays | 8:00 a.m.- 1:00 a.m. | " | " |
| W1XAL Boston | Sundays | 5:00 p.m.- 7:00 p.m. | 6,040 | 49.6 |
| | Mondays and Fridays | 7:00 p.m.- 9:00 p.m. | " | " |
| | Mon., Tues., Wed., Thurs. and Fri. | 6:00 p.m.- 6:30 p.m. | 11,790 | 25.4 |
| | Saturdays | 4:00 p.m.- 6:30 p.m. | " | " |
| W9XAA Chicago | Sundays | 7:00 a.m.- 3:35 p.m. | 11,830 | 25.3 |
| | " | 4:00 p.m.-11:00 p.m. | 6,080 | 49.3 |
| | Mon. to Sat. inclusive | 5:30 a.m.- 7:00 a.m. | 6,080 | 49.3 |
| | " " " " | 7:45 a.m.- 3:45 p.m. | 11,830 | 25.3 |
| | " " " " | 4:00 p.m.-11:00 p.m. | 6,080 | 49.3 |
| W9XF (NBC) Chicago | Daily (except Saturdays) | 11:00 p.m.- 2:00 a.m. | 6,100 | 48.1 |
| W8XAL Cincinnati | Daily (except Sundays) | 6:30 a.m.- 8:00 p.m. | 6,060 | 49.5 |
| | Sundays | 8:00 a.m.- 8:00 p.m. | " | " |
| | Daily | 11:00 p.m.- 2:00 a.m. | " | " |
| W2XE (CBS) New York | Daily | 7:30 a.m.- 1:00 p.m. | 21,520 | 13.9 |
| | " | 1:00 p.m.- 5:00 p.m. | 15,270 | 19.6 |
| | " | 5:00 p.m.-10:00 p.m. | 11,830 | 25.3 |
| | " | 10:00 p.m.-11:00 p.m. | 6,120 | 49.0 |
| W3XAL (NBC) New York | Daily | 9:00 a.m.- 5:00 p.m. | 17,780 | 16.8 |
| | " | 6:00 p.m.-11:00 p.m. | 6,100 | 48.8 |
| W3XAU (CBS) Philadelphia | Daily (except Sundays) | 12:00 noon- 8:00 p.m. | 9,590 | 31.2 |
| | Sundays | 12:00 noon- 7:00 p.m. | 9,590 | 31.2 |
| | Daily | 8:00 p.m.-11:00 p.m. | 6,060 | 49.5 |
| W8XK (NBC) Pittsburgh | Daily | 7:00 a.m.- 9:00 a.m. | 21,540 | 13.9 |
| | " | 9:00 a.m.- 7:00 p.m. | 15,210 | 19.7 |
| | " | 7:00 p.m.-10:00 p.m. | 11,870 | 25.2 |
| | " | 10:00 p.m.- sign off | 6,140 | 48.8 |
| W2XAD (NBC) Schenectady | Daily (except Sun. & Mon.) | 9:55 a.m.- 3:45 p.m. | 15,330 | 19.5 |
| | Sundays | 10:00 a.m.- 4:00 p.m. | " | " |
| | Mondays | 9:55 a.m.- 4:30 p.m. | " | " |
| W2XAF (NBC) Schenectady | Daily (except Mondays) | 4:00 p.m.- midnight | 9,530 | 31.4 |
| | Mondays | 3:30 p.m.- midnight | " | " |



# CAMERA ANGLES

Conducted by JACOB DESCHIN

## Inventory Time

THIS is a good time of year in which to do some careful weeding in your negative garden. If you take your hobby seriously, you doubtless are finding that you are constantly improving your technique and feeling less and less satisfied with your earlier efforts. Look through your negatives carefully and see how many of them are still worth keeping, considering the higher standards you have set for your work.

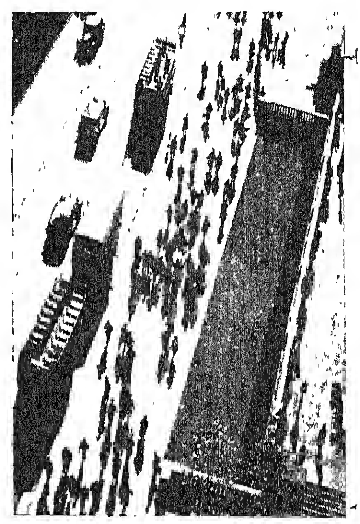
Unless you are a very exceptional photographer, you will find quite a number with which you once were passably satisfied but which today you hold in disdain. Some of these negatives may be valuable to you for other than purely artistic reasons and you cannot be blamed if you will want to keep these, if only for a "little while longer." The others, however, may easily be thrown away and good riddance. You want your negative file to hold only those which you would not hesitate to show to a fellow-hobbyist. If the others are so poor that you find it painful to look at them yourself, waste no time in eliminating them as quickly as possible. Try it and see how much better you feel.

## Diagonals

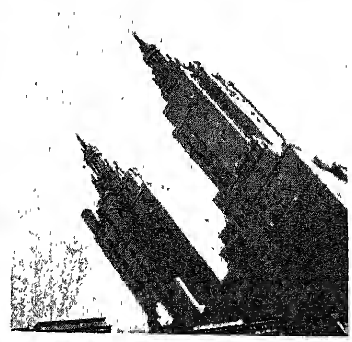
THE diagonal type of composition appeals to many workers who seek to introduce original ideas into their picture-taking. They like its liveliness and vivacity, its devil-may-care atmosphere. The conventional triangular arrangement that is held to be the ideal composition is perfect, but let's do things a little differently now and then; let's try it this way and that way and if we get something pleasing to us let's enjoy it even if it isn't exactly according to Hoyle.

This diagonal form does not necessarily have to involve distortion of the subject nor even call for an angle shot; some very fine portraits have been made which have employed the diagonal line, one beautiful example of this that comes to mind being that of a girl, in which the head is in the upper right hand part of the picture space and a shoulder in the lower left hand part, the two being related by an invisible diagonal line.

The distinctive characteristic about the diagonal composition is that the picture in which it is employed seems to come alive; it is alert, active, full of movement. Now, if we can get this spirit into our pictures what does it matter if some die-hards, purists, or whatever they call those people who refuse to go along with the new times and the new spirit, object to these new-fangled notions? The diagonal line is, of course, not new, and has always been employed, but the point we make here is that we should exploit it in a more striking way than is ordinarily attempted. Two such possibilities we offer in our illustrations, "Twin Towers" and "Pedestrian Shadows." In the former we get the impression that these "skyscrapers" live up to their name, that they are not just inanimate mountains of stone and steel but vibrant with modernity, conscious of and reflecting the life that is going on within and about them.



"Pedestrian Shadows"



In "Pedestrian Shadows" we feel the rhythm of many lines running parallel from the lower left hand corner to the upper right hand corner and yet escaping monotony by reason of the varied shapes and the two short diagonal lines of the stone fences that run counter to the principal lines in the picture. The active forms of the people walking up or down the avenue and the shadows cast by their persons, the rounded-off forms of the buses and automobiles all contribute essential touches to the general atmosphere of continuous movement.

Buildings, street scenes, and portraits seem to offer the best subjects for the diag-

of surprises it is possible that we may run across a happy composition of this type in almost any subject. If we cannot get into position for the diagonal composition we want, it is often possible to correct this viewpoint under the enlarger. Thus, while "Twin Towers" was snapped in the position it was printed, "Pedestrian Shadows" had to be maneuvered into the diagonal by lifting the enlarger housing higher than would ordinarily be required and then moving the easel about until the desired result was obtained.

Incidentally, while we are on the subject of essaying new fields and breaking away from old traditions when we find these no longer fit the mood of our times, let us recommend that finest of exercises for the serious worker: the still-life. There is no better way to become thoroughly familiar with the various compositional forms or to evolve new ways of putting them to work. A table, a few knick-knacks or pieces of fruit, simple lighting equipment, and a camera equipped for ground glass focusing, although the direct view finder can, with a little extra trouble in focusing, be made to serve, are all the tools you will need.

## Timing Clocks

TWO inexpensive darkroom timers, one of which sets off an alarm at the end of a predetermined time interval, are now available in photographic stores. One is the Rexo Interval Timer, which provides for intervals from one minute up to 60, an alarm going off at the pre-set time, and the other the Luxor Photo Timer, which is a double-duty clock, serving both to tell the time of day and the time of exposure for printing or developing purposes. The latter has a full-sweep second hand and smaller hour and minute hands. Both timers have large, open-face dials four inches in diameter.

## "Bargain Hunters"

THE wealth of pictorial material available to the picture-taking wanderer about the streets is again illustrated in the "Bargain Hunters," which was snapped while this department was on its way to the office one morning. An "economy sale" was in progress and the rush of customers to the counters created a succession of picture opportunities that could not be ignored even at the risk of reaching the office late. No posing, no pre-arranged lighting, nothing but life in the living.

## "Mystery Crystals"

WE have a puzzle for our readers this month. Let us say at once, without further ado, that the subject-matter in "Mystery Crystals" is nothing but the accumulation of spilled developer and hypo solution which had collected on a slightly grooved board and had carelessly been allowed to stay there for several days. Crystallization occurred with the result you see. It took a short focus lens, cross lighting, and precarious placing of the camera to get this picture and two or three others, but as a picture of an unusual darkroom mystery it seemed worth while recording.

"Mystery Crystals"

## Direct Copy Film

A METHOD of making copies of negatives, without the necessity of going through the intermediate step of first making a positive, is now made available in Agfa Direct Copy Film, which takes practical advantage of the "solarization" principle to achieve its effect. It is also useful for making positives and transparencies and in these cases, too, the duplication is direct; a negative from a negative or a positive from

a positive in a single exposure and development.

It is in its ability to turn a negative into a negative directly that this film holds a special appeal for this department. Consider the great advantage of copying a 35-mm negative on a 4 by 5 or 5 by 7 film. Prized negatives may thus be better preserved and only certain portions of them, when desired, retained in an improved composition. Dodging may be resorted to as in ordinary enlarging in order to permit control of contrast and density, and retouching is made possible on the larger negative that is not feasible on the miniature type.

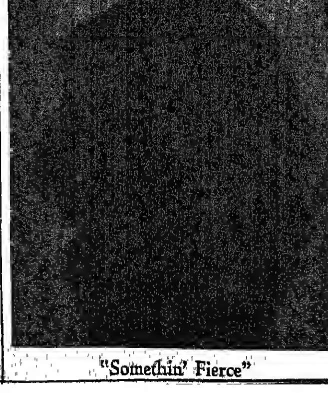
The usual darkroom light used for contact printing is employed in handling this direct copy film and development and fixing is in conventional solutions. The film sizes available range from 4 by 5 inches to 20 by 24 inches, including the popular 5 by 7 and 8 by 10 inches.

## View Camera

A VERSATILE 5 by 7 view camera intended for the professional but just as useful to the serious amateur who prefers the leisurely convenience and other advantages offered by the view type camera, has recently been introduced by Agfa Ansco under the name of the Universal Junior View Camera. The camera is sold, as all view cameras are, without the lens and in its design are incorporated many modern features, such as the new tilting front action with rising and falling front movement; horizontal and vertical back swings; reversible ground glass back and rack and pinion focusing. The bellows extension permits of the use of lenses varying in focal length from 3½ to 13½ inches. Despite these advanced features, the camera is priced very reasonably, the cost including a carrying case, an extra lens board, and a double film holder.

## Newspaper Shadows

TAKE a sheet of newspaper, crumple it loosely and throw its shadow on a plain, light-toned background, preferably using a spotlight for sharp shadow edges. At first you may not see anything that looks like sense, but turn the crumpled bundle this way and that and perhaps eventually you may get something like the results shown here in "My Land!" and "Somethin' Fierce." The peculiarity of this method of killing time is that you may get nothing at all for



"Somethin' Fierce"

"My Land!"

quite a while so that after 15 or 20 minutes of this exercise you may suddenly reach a point when you find yourself slowly but surely losing your mind. But to give up at this point would be fatal, since it is just here that you will really be getting into the swing of the thing.

In photographing the final goofy result you will very likely have to include both the newspaper and the shadow, but there is nothing to prevent your cutting out the newspaper part of the negative when you come to make the enlargement.

The intriguing thing about this whole business is that you cannot predetermine the result. Almost anything is likely to appear, perhaps just when you have decided to give up. If the crumpled sheet you have been "modeling" seems to produce no results at all, just discard it and take a fresh sheet. It's all a matter of luck, but you are bound to get something if you approach the thing good-humoredly. At the worst, it's one way of spending a rainy afternoon indoors or whiling away a dull hour or so.

## Timing Prints Automatically

ONE of the handiest devices to appear on the market in recent months is an automatic time switch that eliminates watching the clock when making prints and enlargements by automatically switching off the printing light when a pre-set number of seconds has elapsed. It is known as the Simmon Automatic Time Switch and may be connected either to an A.C. or D.C. outlet. The enlarger or printer cord is plugged into the socket at the back of the switch case, a focusing switch turned on to frame and focus the image and then turned off when ready to make the exposure, after which an indicator is turned to the number of seconds required for the exposure. When the exposure switch is released the printing light goes on and stays on for the exact duration of the exposure, when it automatically is turned off. The advantages of this device are, of course, obvious to all darkroom workers, two of the most important being that dodging is greatly facilitated since the clock does not have to be watched and the attention may, as it should, be entirely concentrated on the work of dodging, and exact matching of tone values assured where a number of prints are made from a single negative.

The Simmon Automatic Time Switch is also recommended for making automatically-timed camera exposures from 1 to 60 seconds when working with Photoflood bulbs. The time switch is connected to the circuit carrying the bulbs and the control knob set for the exposure time required. The

exposure switch released to time the bulbs rather than the camera shutter. This procedure is familiar to those who have used the non-synchronizing type of flash bulb reflector, the shutter being closed, of course, immediately after the lights are switched off. It is advised that the bulb units should be limited to two No. 1 or one No. 2 Photoflood bulbs.

## Hung Again

"THE Artist at Work" is one of five of this department's pictures hung during the entire month of December in a national exhibition of the work of American photographers at the University Gallery of the University of Minnesota. We are es-

"The Artist at Work"

pecially partial to this particular picture and this occasion seemed like a swell opportunity for getting it by the powers that be and showing it to our friends. Modesty aside and speaking objectively, if this is possible, we like this picture for several reasons: the dark mass at the right, the leisurely concentration of the "artist" at her work of arranging the dress, the easy, unforced pose of the shoe-less window dresser and the soft, general illumination against which the subject is semi-silhouetted. The picture is a candid shot taken at night while in casual search for likely picture material.

## New Adhesive Tape

A NEW adhesive tape coated on one side only and having a crêpey paper-like base and vulcanized rubber back is now being recommended by supply dealers for use in masking and passe-partout binding, as well as for a variety of other purposes allied with photography. On the market under the name Papertak, it is supplied in a variety of colors, including blue, yellow, brown, green, and red as well as black and white, and in widths of one quarter, three eighths, one half, three quarters and one inch, and in rolls 10, 30, and 60 yards long. Its sponsors claim that it will not curl, resists heat and water, cannot be penetrated by paint, varnish, or lacquer and leaves no surface marks when removed.

## Another Market

A PAYING outlet for your writing as well as picture-taking talents is now in the course of getting under way in Chicago in the form of a new magazine devoted chiefly to photography. It is being launched by the Ziff-Davis Publishing Company, 608 South Dearborn Street, Chicago, whose B. G. Davis is inviting suggestions from prospective contributors. In a recent letter to this department, Mr. Davis announces that the requirements of the new magazine will be for non-fiction articles dealing with still photography and cinematography as well as color work and that these "must be of a technical or semi-technical nature, written in fairly simple language."

"Squibs can vary from 100 to 500 words, articles from 1000 to 3500 words," Mr. Davis's announcement continues. "Ghost written articles from important photographers will be very useful. Articles, of course, should include illustrations wherever possible.

"We will also be in the market for a limited number of good or unusual photographs of all types, including color photographs. Home construction articles dealing with cameras, enlargements, dark room activities, etc., will be needed."

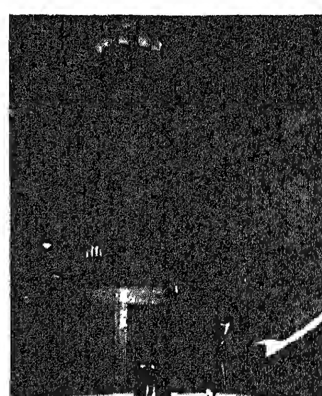
So if you have something worth while to say, either with words or pictures, don't waste it on the desert air but write Mr. Davis about it and let him send you a check for your trouble. Mr. Davis writes he "will be glad to confer with any contributor in advance regarding proposed articles."

## Ferrotype Cleanser

BRIGHT, non-curling glossy prints may now be obtained through the use of a new solution for cleaning and lubricating enamel or chromium ferro tins. Ferolene, its trade name, merely calls for mixing a small quantity of it in a pint of water after which a sponge soaked in the mixture is passed over the tins and the washed prints pressed over them in the usual manner without the necessity of first drying the tins.

## Shoot the Red Caps

WHEN next you have occasion to visit New York City, do not overlook the pictorial possibilities of Pennsylvania Station. At certain hours of the day, depending on the time of year, sunlight comes stream-



"Red Caps"

ing through the upper windows and down the stairways, illuminating all subjects descending the stairways or standing or walking within a rectangular area measuring 12 or 15 feet by 20 or 30 feet. Prospective passengers coming down the stairs are beautifully "back-lighted" and other subjects present themselves in a very attractive setting, but your best opportunities will be in snapping the Red Caps at their daily

train and back again. Their stiff caps catch the light beams and their swinging arms and alert movements are silhouetted against the generous illumination. Candid-shooting gets a real break in a setting of this kind and either the range-finder or the reflex type of camera will be found ideally useful.

## ANOTHER WORD FOR THE HORSE

SOMETIME ago we voiced the suggestion that the city horse going about his daily work in city and town is worth some photographic attention. Permit us to do so again,

*"Horse in the Rain"*

if only in order to have an excuse to show you the accompanying picture. There was a slight drizzle when this shot was made but we found that by standing in a nearby store doorway we were able to cover just the amount of material we needed, except for too much foreground, which was easily eliminated in the enlargement. The shot was made at F:2 and by steadying ourself against the store window we were able to give a 1/5th second exposure.

## LIGHT FOR COLOR

A FLOOD bulb lasting five hours and specially designed to provide a filtered light in order to do away with the need for using a filter when exposing Dufaycolor film, is the Wonderlite Dufaycolor Filter Flood. The glass of the new lamp is colored to approximate the effect of the Dufay standard 1A filter. The manufacturers claim that "the color rendition should be faithful during the entire useful life of the lamp."

The manufacturers caution prospective users that, when employing the Weston or any other photo-electric meter in determining exposure, the meter reading should be multiplied by four, since the effect of the bluish-white light of the Filter Flood on the meter is only about one fourth the effect of white light.

It is suggested that the Filter Flood may also be used with supersensitive panchromatic film in portraiture, its special virtues in this connection being that it reduces eye strain and glare and throws less heat on the subject. The general advice is to use a factor of two to four, depending on the color of the wall, screen, or picture setting, the multiplying factor being determined

## THE SCIENTIFIC AMERICAN DIGEST

(*Continued from page* 117)

for 15 or 20 minutes. Then seal the jars and leave them in the water until it begins to cool. Store the jars in a dark room or cover to keep them from the light. Thus processed, nut meats will keep fresh even during hot weather."

### Colored Insecticides for Aphids

THAT the color of the insecticide used may have a definite effect upon the number of insects attracted to the host plant has been demonstrated in tests made at the State Experiment Station at Geneva, New York, and reported upon recently by J. B. Moore.

The experiments were carried on with aphids on potatoes because it had been observed that aphids tend to increase in numbers on plants sprayed with bordeaux, explained Mr. Moore. By the aid of delicate instruments it was possible to test the light responses of aphids to sprayed and unsprayed potato leaves. From the results obtained it has been concluded that the aphids are attracted to the sprayed plants because of the increased intensity of light reflected from the sprayed surfaces.

Extending his studies to aphids on cabbage, Mr. Moore found that the infestation on plants dusted with a lead arsenate-lime mixture could be reduced below that on untreated plants by dyeing the dusts used. Black dust was the most effective in reducing the infestation.

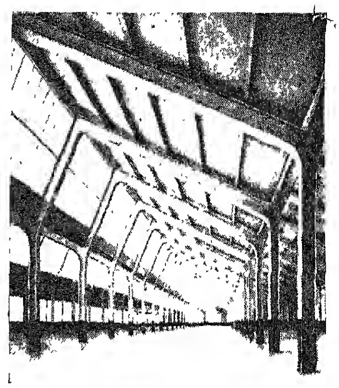
It is believed that the results obtained in these experiments might well lead to modifications of present spraying and dusting practices on crops infested with aphids by using dyed materials to insure a reduction in the light intensity reflected from the treated surfaces.

### Broader Factory Aisles

A NEW design for single-story industrial buildings, providing broader factory aisles, unobstructed head-room to full ceiling height, and maximum uniform daylight throughout, has been developed by The Austin Company, industrial engineers and builders, through the use of welded rigid frame construction.

Entirely stripped of cross members and trusses which cast spider-web shadows across most factory areas today, the new type has a continuous rigid saw-tooth frame formed by the welding of rolled beam sections which permit economical construction of aisles up to 50 feet in width. It is particularly adaptable to requirements of machine shops, precision parts production, and the textile, food, and printing industries, where air-conditioning is a factor of increased importance.

"Application of the latest engineering practice will permit the attainment of simple functional lines in plants of the future," Albert S. Low, vice president and chief engineer of the Austin organization, states. "By taking advantage of a system which



Welded-frame building construction makes possible broader aisles

tooth type, it will be possible to eliminate all passing shadows caused by transitory sunlight and to insure more efficient and uniform artificial illumination at night.

"With broader aisles available, and clear, unobstructed head room from floor to roof, men responsible for production will have the maximum opportunity to develop efficient and flexible operating layouts for the future. Straight line operations in any of several directions will be possible."

### Tin Kills Dry-Goods Odor

THE odor characteristic of dry-goods stores may become merely a memory as a result of a new use found for tin. Compounds of tin, such as stannous oleate, stearate, or benzoate, when added to the extent of 0.1 percent to the oils used in finishing textiles, prevent the rancidity which imparts undesirable odor to the finished goods. This use of tin compounds as anti-oxidants in textile oils minimizes the odor of new cloth.—*D. H. K.*

### Research in Muscle Flight

THE Germans have been pioneers in gliding flight, beginning with the great Otto Lilienthal. Now they are undertaking very seriously the study of flight by man-power alone, or *muskelflug* as they term it. A prize has been established for the first real flight by man-power, as distinct from gliding or soaring, and the rules of the contest provide that all starting devices such as rubber bands, and so on, are to be taken aloft. In writing these rules, one of the most difficult problems was to evaluate how much power a man really can produce—it is on the correct evaluation of such power that everything depends.

Information on man-power seems to be vague and conflicting, so with true German thoroughness an Institute for Muscle Flight was established in Frankfurt, with correct measurement of leg and arm power as one of its first tasks.

Some curious apparatus has been developed for this highly scientific research. The subject sits in an adjustable seat and works with his feet on pedals moving in circular arcs, with one foot alternately ahead of the other. With his arms he manipulates cranks in similar fashion. Through gearing and a chain drive the power is transmitted to a Prony brake. The turning mo-

revolutions per minute. The engineer pulls out his slide rule and calculates the man-power developed, on the same principles that he calculates the power during test of an internal combustion engine.

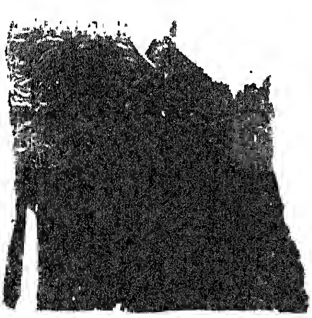
Information to date leads to the belief that man will be a weak prime mover and will develop considerably less than one horsepower even in a frantic burst of a minute's duration—but we shall see. Of course, the Institute will concern itself equally with aerodynamic problems.—*A.K.*

## WELD OF .000006-INCH FOIL

STRIPS of two alloys, Copnic and Chromel, were welded together and rolled to a thickness of six millionths of an inch recently in the laboratories of the General Electric Company. Even when magnified 250 times, the weld in the ultra-thin bimetallic foil can be distinguished only by the difference in color between the two alloys.

Gold has been beaten to four millionths of an inch, and aluminum has been thinned by the same treatment to ten millionths of an inch; but this is the first time two alloys have been welded together and then reduced to such a thin section by rolling.

The six millionths of an inch thickness was achieved by placing the welded strips of the two alloys—the one of copper and nickel and the other of chromium and nickel—between pieces of steel and reducing the combination as a unit by passing it between rolls. The final product of the rolling process is as delicate as gold leaf and must be handled with equal care.



A perfect weld of two pieces of alloy foil rolled to .000006 inch

The two alloys might have been lap welded after being rolled, according to engineers in charge of the work, but such a procedure would not have given the same clean appearance and uniform characteristics. Rolling is the only method known by which such extreme and uniform thinness can be obtained in metals.

## RAINFALL REGISTRATION

A NEW instrument for the registration of rainfall, described by the Swedish meteorological expert, J. W. Sandstrom as the finest yet devised, has been invented by a doorkeeper at Swedish Meteorological Hydrographical Institution. It is characterized by its light weight—only 18 kilograms (40 pounds) against 60 kilograms (132 pounds) of other instruments—the great accuracy of the readings, and the fact that it registers had observed that self-registering rainfall instruments were not efficient and accurate, and pondered over the problem for several years. At last he found the solution and made his first instrument. Now there are several in operation in Stockholm and other parts of Sweden.—*Holger Lundbergh.*

## NEW VITAMIN-ANALYSIS METHOD

LIGHT given off by a vitamin, strong enough for newspaper reading, was the unique phenomenon witnessed by doctors attending the American Medical Association's annual session. It was observed during the first demonstration of a vital, new short-cut method of calculating the content in foods of lactoflavin, one of the vitamins essential in the diet to promote growth and sustain life.

The new method of analysis is based upon the discovery of the fact that lactoflavin throws off an intense golden yellow, fluorescent glow when it is exposed in a completely darkened room to "black light," the invisible ultra-violet rays of the spectrum.

For the past 13 years Dr. Supplee and his associates in the biological and chemical laboratories of The Borden Company, in Bainbridge, N. Y., have been working to isolate and study the unknown factors in milk. Whole milk has long been known to contain all of the health-giving vitamins but there has been much mystery concerning many of its minute constituents, of which lactoflavin is one. Lactoflavin is a water-soluble vitamin formerly classified as a part of vitamin B or G.

"Understanding of what constitutes a healthful diet is broadened whenever a vitamin is isolated, purified and brought under scientific control," Dr. Supplee asserted. "Accordingly, our efforts have long been directed toward the development of methods of isolating and producing lactoflavin, which is so vital to mankind. Our success was recently accelerated by the discovery of the unique fluorescent property of the vitamin."

Lactoflavin is the fifth vitamin to be isolated chemically, the others being vitamins A, B, C, and D. The potential source of supply of lactoflavin is almost unlimited. In milk, lactoflavin has been found to be in the proportion of between 1½ to 2 parts per million, with approximately the same proportions existing in liver, yeast, milk solids, and whey. This may appear to be a very small proportion of vitamin material but these vitamin agents are effective in minute quantities.

## HOW AIRCRAFT ENGINE VIBRATION IS ELIMINATED

IN a paper presented before the S.A.E., John M. Tyler discussed the vital problem of vibration in aircraft engines. No matter how well balanced an aircraft engine may be, there is always one source of irregularity which cannot be eliminated; namely, the torque or turning moment of the engine. Even with 14 cylinders, there are bound to be irregular torque impulses. The engineer knows that he cannot eliminate this irregularity and takes the following precautions:

The engine is rubber-mounted so that

the rubber mounting is made relatively flexible so that the natural period of swing or oscillation is much longer than the period of the torque impulses. In other words, resonance is avoided. Similar principles of mounting are followed in the automobile engine.

The avoidance of excess vibration is mainly the avoidance of resonance. Resonance is a well nigh universal phenomenon: A child working a swing uses the principle of resonance; soldiers break step when crossing a bridge so that their steps may not be in resonance with the natural period of the bridge; it was the resonant whirling of its propeller shafts which made passengers on one of the world's largest ocean liners uncomfortable on its first trip.—*A. K.*

**THIRSTY ORCHARDS**

**If a mature orchard receives its needed four acre-inches of rainfall each month, it would be equivalent to 108,000 gallons of water to the acre monthly or 3600 gallons daily, says the Bureau of Plant Industry. Counting an average of 35 trees to the acre, each tree should have a little more than 100 gallons of water daily.**

## Brake the Trailer Now

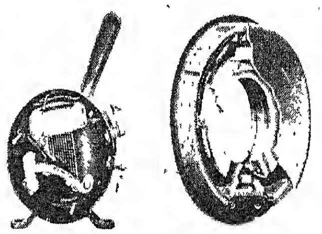
Answering problems and peculiarities arising in the trailer field, Warner Electric Brake Manufacturing Company has announced development of a new electric power brake for coach and commercial trailers.

The brake, operating on as little current from the storage battery as a tail light, involves several new principles. From a trailer standpoint, one of the chief advantages is that only one electric wire is needed as connection between the power car and the trailer, permitting free movement of the coupling in turning. Electric brakes have a further advantage in speed and ease of operation and apply a powerful braking force which is under complete control of the driver.

When the driver depresses the foot pedal (or moves the hand lever) a simple controller, acting like a rheostat arm, sends electric current from the battery to an electro-magnet in the brake. This magnet, circular in shape, can revolve in either direction within a limited arc. The current energizes the magnet and causes it to cling to an armature disk mounted inside the brake drum. The armature revolves with the drum and is kept in constant contact with the magnet by means of flat springs. The farther the foot pedal is depressed, the greater is the amount of current that reaches the magnet and the tighter the magnet clings to the armature. This attraction of the magnet to the armature causes the magnet to start turning with the armature. As the magnet turns, it engages a cam lever which, in turn, expands the brake band evenly against the brake drum in the conventional way.

From a mechanical standpoint, the brake construction is simple. No complicated wiring is required—just a single wire leads power from one part of the wheel to the other.

The electric brakes act instantly, without time lag. The controller delivers current to all wheels simultaneously, and the stopping action begins at once. The driver has complete control over the amount of braking power with a minimum of effort. "Grabbing" and "locking" are eliminated as there is always a slight slipping action between armature and magnet. "Jack-knifing," due



*Left:* The rheostat controller for trailer brakes. *Right:* Cut-away view of brake, showing the mechanism

to the towed vehicle skidding in one direction and the power car in another until the trailer ends up against the running board or other projecting parts of the power car, is prevented because there is no time lag between application and operation.

Current is fed equally to all brakes at the same time. Bands are expanded against the drums evenly, and as brakes on both trailer and power car function simultaneously, "pull" and side-sway are eliminated.

Weather conditions cannot affect the power of the brakes. The electric current consumed is so small that connections between power car and trailer will not short-circuit even if the bare terminal is submerged in water.

If the power car is standing still and the current turned on there is no action of the brakes. Let the wheel revolve in the slightest degree, however, and the braking power is actuated. The magnetic clutch goes into action only when the wheels are revolving.

## Encouragement

The pessimism of specialists in the field of heredity has painted heretofore only too gloomy a picture of the probable future of the offspring of the mentally ill. Against such a dark background, a new bright spot of knowledge shines with a heartening glow.

Mental disease is all too familiar to most of us. It is so common that few among us are now able to say that no relative or friend is unfortunate enough to need hospitalization for this pathetic type of illness. In fact, it has been estimated that one out of 22 persons in the United States may expect to become mentally ill some time during the course of his lifetime.

It is cheering to read in a recent issue of *Mental Hygiene* that the children of a parent with dementia praecox—a disease generally conceded to be at least partly of hereditary origin—have themselves an excellent chance of being normal.

In a follow-up study, Dr. Myrtelle M. Canavan, pathologist to the Massachusetts Department of Mental Disorders, and Rosamond Clark, of Boston, were able to locate 117 out of 381 children of dementia praecox

for treatment for a mental disease so far as the investigators could find, and it may be assumed that such news would be most readily discovered. Nine were dead.

Of the 108 still living, 58 or more than half were apparently entirely normal. They had never come to the attention of hospitals, courts, guardians, truant officers, or others dealing with the incompetent. Here is the story of that other 50 who deviated from the "normal":

Epileptic, 9; insane, 3; feebleminded, 8; backward, 6; nervous, 3; physically diseased, 3; cases of conduct disorder, 27. All but three of these "deviates" suffered from the handicap of the loss of the mother from the home, because in 47 cases it was the mother who was mentally ill.

Compare this story with that of a group of 581 children of non-psychotic parents used as a control for the investigation. In this group 2 were insane, 10 feebleminded, 12 backward, 12 nervous, and 101 physically diseased.

Apparently the conclusion to be drawn is this: The child of a parent with dementia praecox does not have quite as good a chance of becoming a normal adult as does the child with healthy parents. But it is much more probable that he will be completely healthy and normal than it is that he will need hospitalization for mental disease during the early years of his life. —*Science Service.*

## Don't Breathe Dust

PNEUMOCONIOSIS has been in the news recently because of the claims that, at a job in West Virginia, many workers developed pulmonary diseases because of the inhalation of dust produced on the job. This problem, one which has long troubled re-

Dust cannot get through this mask

search workers in the fields of mining, quarrying, and engineering particularly, has been the inspiration for numerous inventions to prevent production of dust or to prevent its inhalation by workers. In the latter category is a newly created respirator which has the advantages of comfort, light weight, and compactness, to say nothing of its high efficiency and easy breathing ability.

As shown in the accompanying illustration, the Dupor plate respirator fits tightly to a nose of any shape, with a face cloth which may or may not be used for comfort. Two large filter pads permit easy breathing through both the nose and the mouth. These

One of the most important improvements is that there are no clamping or holding devices.

The filter pads have been tested by the U. S. Bureau of Mines and approved for Type A Dusts, No. BM-2111, which are the pneumoconiosis producing dusts that it is so desirable to avoid.

## Utopian Morsel

THE succulent tender steaks of the skilled chef may soon become commonplace home fare, lacking only the overture of the grimacing waiter and the finale of the overgrown check. Methods of tenderizing tough meat are being investigated and eventual success seems indicated by results already obtained.

The tenderness of the smart restaurant's excellent beef has been obtained by hanging, by the natural ageing of incipient decay. Patrons would probably refuse such meat if it were delivered by the butcher on demand for specially fine steak for a holiday dinner. Its appearance uncooked is not necessarily appetizing, yet the hanging of beef and game is as old as the art of the master chef. It is perhaps unfortunate that the procedure is not readily adaptable to modern retail distribution and use.

The natives of certain tropical areas, where high temperatures make such hanging or storage impossible, are known to use other tenderizing methods. They wrap freshly killed jungle game in the leaves of the papaya plant for a few hours before cooking. The papaya contains fluids that soften or digest the proteins of the meat—in brief, proteolytic enzymes—and so their enzyme-treated meat is tender when cooked. It is materials of the same type as these papaya enzymes that are being considered in certain modern food laboratories; pepsin and trypsin, for example, have much the same action, although both affect taste adversely. Enzymes are natural products and certain of them are distributed by pharmacists as aids to digestion.

A recent patent covers the treatment of beef and other meat at the stock yards, by forcing the tenderizing fluid into the vascular system of the freshly killed stock. It is indicated that the toughest old range steer can thus be made tender. The best beef draws a premium as much for its tenderness as for its flavor; recent government blindfold tests have even revealed difficulty in distinguishing between beef, lamb, and pork. Nice questions are thus raised for food inspection authorities who will realize that many interests may be affected by any endeavor to market tenderized low-priced meat. McGraw-Hill's *Food Industries* notes a new food softener from Japan. The bottled powder, said to be made from a proteolytic enzyme, softens albuminous food within a few minutes without changing flavor or color. One packing company ages beef in a third the time ordinarily required, at the same time eliminating the customary spoilage loss. This is accomplished merely by appreciably raising the temperature and humidity of the ageing room, and preventing the otherwise heavy surface deterioration by irradiating the meat's surface with a fungicidal ultra-violet lamp offered by Westinghouse for this purpose.

Already one product said to be an extract of papaya is being offered for sale to restaurants and hotels as producing tender steaks

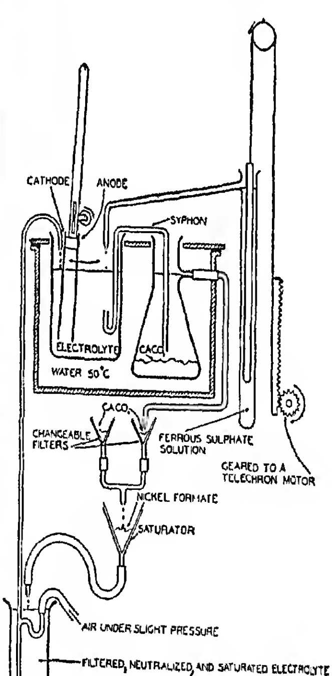
from cheap cuts at a cost of a cent or two. The liquid is painted on the meat five or ten minutes before cooking, and it is reported that the treated steak may be cut with a fork. Whatever the merit or success of products or methods now available, there is every prospect that in due time even cheap meat will be tender.—*Industrial Bulletin* of Arthur D. Little, Inc.

## Millions in the Air

THE air is full of tiny insects and other living matter that have been swept high above the earth by air currents, according to *Nature Magazine.* Numerous flights of airplanes carrying traps for collecting insects in Louisiana revealed that a column of air one mile square extending from 50 feet to 14,000 feet above the ground contains on an average for all seasons about 25,000,000 insects, the range being from 12,000,000 in January to 36,000,000 in May.

## Better Electroplating of Alloys

A NEW method of electroplating alloys more accurately and conveniently has been patented by Kersten and Young of the University of Cincinnati. The method, which uses an insoluble anode, has been applied to the electroplating of nickel-iron alloys from a bath kept saturated with




**Apparatus for electroplating alloys**

nickel formate to which ferrous sulfate solution is added continuously. The acid formed by the process of electrolysis is continuously neutralized by passing the solution over calcium carbonate. The new process produces an alloy of uniform composition which was difficult to secure by older methods. The inventors state that the process is limited to those cases where one of the materials can be plated from a saturated solution, where the solutions do not react disadvantageously with each other, and in composition over a long period of plating from the same solution but the composition of the alloy can be varied by appropriate changes in current density and composition of the bath. The process offers a convenient method of electroplating permalloy on electric wires.—*D. H. K.*

## Fertilizing from the Air

A RATHER new kind of farming—with fertilizer applied to the atmosphere instead of the soil—has been tried on a miniature scale at the Smithsonian Institution with marked success. Wheat plants were grown by Dr. Earl S. Johnston of the Division of Radiation and Organisms in atmosphere containing about four times the amount of carbon dioxide found in normal air.

It is from carbon dioxide, taken from the atmosphere, and water, that plants build up their substance through the process of photo-synthesis, which takes place in light. On clear summer days, sunlight is intense enough to increase the rate of photo-synthesis were this process not retarded by the limited amount of carbon dioxide available in normal air. With wheat in an atmosphere *enriched with carbon dioxide,* Dr. Johnston reports, the weight of straw, the number and weight of heads, and the number of grains were increased, in comparison with plants grown in ordinary air.

The Smithsonian wheat fields were only four square feet in area. They were enclosed on four sides with glass, leaving the tops open. Within this glass enclosure, around the growing plants, a fairly constant stream of carbon dioxide was kept in circulation.

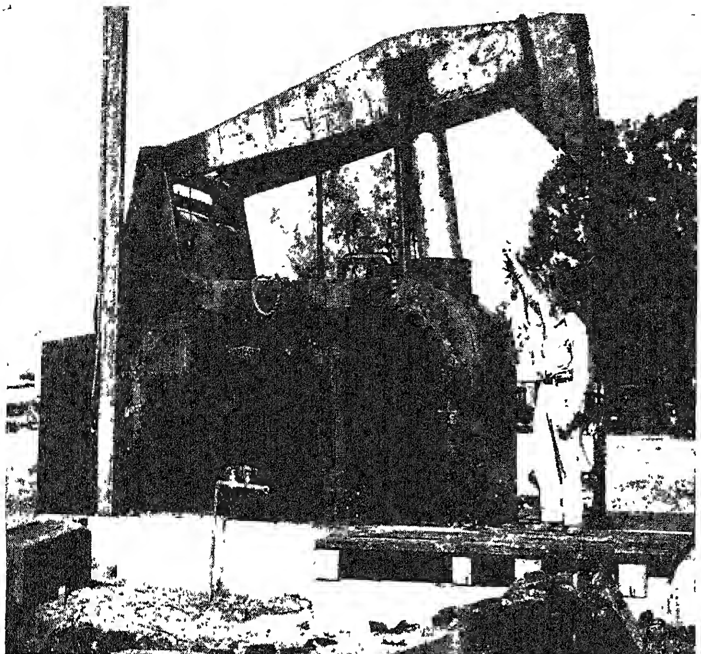
Dr. Johnston says in his report: "The practical application of this type of fertilization in field experiments and the supply of carbon dioxide in sufficient amounts for practical field work are still unsolved problems, in spite of the work that has been done. While experiments in which carbon dioxide is used as an aerial fertilizer are of importance scientifically, the practical application of this type of fertilizer in commercial work is far from satisfactory, although its application to greenhouse culture appears to be most promising."

Because of the problem of confining the gas over large areas in open fields, he points out, there is at present little practical application of his results to open-air farming.

## How It Feels to Fall

AN excellent and scientific account of free falls (that is, falls prior to opening of a parachute) is given by Captain Harry C. Armstrong, M. D. of the Army Medical Corps in the *Journal of the American Medical Association.* Captain Armstrong allowed himself to fall for 11 seconds over a distance of 1200 feet before opening his chute.

His report of his reactions is distinctly encouraging. "Throughout the free fall, all conscious mental processes seemed normal. As soon as the airplane was cleared, fear and excitement disappeared. Consciousness was unclouded and ideation was rapid, precise, penetrating, and clear. There was no nausea or vertigo, although I am quite



Photograph from Mitzanoff

**Possibly less picturesque in appearance than some of the more familiar oil-field equipment, but certainly more efficient, is this newly developed hydraulic-electric pumping unit used for heavy-duty service in Los Angeles oil fields. Not only does it have greater capacity, but it is practically silent in operation**

was none of the empty or 'gone' feeling in the abdomen so common in elevators or airplanes. Breathing was even, regular, and undisturbed."

No doubt this will encourage many of our readers to try a parachute jump at the very earliest possible opportunity!—*A.K.*

## Stutter Intentionally to Stop Stuttering

If you stutter, learn to stutter well. Once you have become an expert stutterer, you will find you can speak without stuttering. This is the advice given by Prof. Herbert Koepp-Baker of Pennsylvania State College to stuttering students, says *Science Service*. He announced that this rigorous program of self-discipline has proved successful in helping stutterers and stammerers overcome their speech difficulties.

The stuttering-on-purpose method is only one part of a broad program for correcting speech defects which is available to students at the college and to persons in other communities throughout Pennsylvania. The program also includes tests for right- or left-handedness and gradual training of the stutterer to use the hand nature intended him to use, as shown by the tests.

## Droughts Don't Last Forever

The great farming and grazing area of the north central United States last summer was near the bottom depth of what appears to be a 46-year precipitation cycle in some way associated with cyclic variations in the radiation output of the sun. This is indicated by records of the water levels of the Great Lakes since 1837.

The 1934 and 1936 droughts constitute 23-year weather cycle, the discovery of which was announced three years ago by Dr. Charles G. Abbot, Secretary of the Smithsonian Institution, after intensive analysis of world weather records and other climatic data. The discovery announced by Dr. Abbot was, in brief, as follows:

Temperature and precipitation variations at any particular place on the earth's surface have a marked tendency to repeat themselves every 23 years, which is double the 11½-year sunspot cycle well known to astronomers. This actually has happened in the north central United States, the water level records show, in the four 23-year periods since 1837. The general contours of the curves of the water-level variations for each of the 23-year intervals are very similar.

It so happens, however, that the most extreme variations repeat at 46-year intervals, or double the 23-year cycle, in that particular area.

In 1837-38, as is shown best by the chart of Lake Huron published by Dr. Abbot, the level was very high, indicating an abundant rainfall all over the drainage area of this body of water. There was a steady decline from that point, the climax being reached about 1848. Rainfall then increased steadily for approximately five years, after which there was a minor decline and another upward swing, continuing until the end of the 23-year period in 1859.

The next cycle included the years from 1860 to 1882, inclusive. Its features were approximately the same as to time, but the extremes of drought and precipitation were much less marked. The depth of the dry weather came in about 1872, but apparently was not sufficient to cause much excitement.

The next cycle was that from 1883 to 1905. The extremes were much more marked. The general pattern very closely duplicated that of the 1837-1859 cycle. The depth of

was almost as bad as that of 1848—a striking confirmation of the 46-year cycle theory.

The period from 1906 to 1928, inclusive, shows a curve very similar in its general pattern to that of the 1860-1882 period. The present 23-year interval started in 1929. According to the 46-year cycle hypothesis the region should have been getting drier and drier ever since. It has. If the cycle continues true to form the low point should be reached some time between 1938-1940, followed by a rapid upswing.

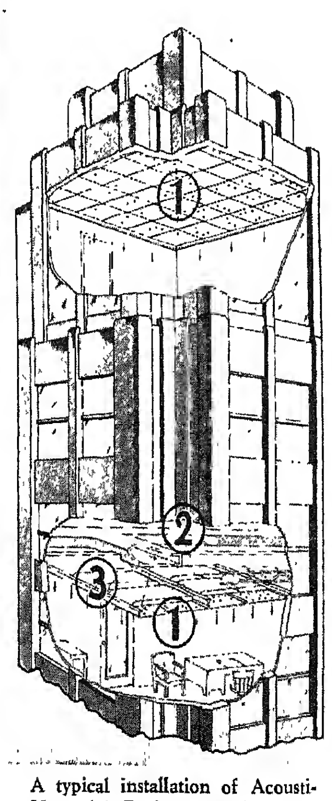
The cycle hypothesis, Dr. Abbot says, gives no support to pessimists who predict that the great drought area will be converted into a permanent desert. There is every reason to believe that history will repeat itself and that the depths of the present drought will be succeeded, at the most a few years hence, by peaks of precipitation.

### ACOUSTICS AND VENTILATION

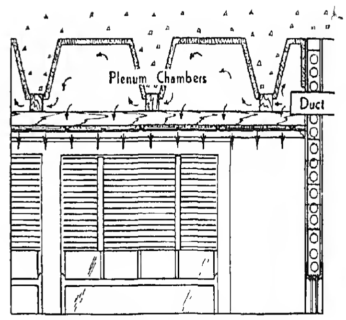
THE rapid development of air conditioning has created new problems of distribution, many of which are not easily solved with the present types of duct systems and ventilating grilles. When air conditioned rooms must also be acoustically treated, the situation increases in complexity.

A new system of air distribution which solves, with one type of construction, the dual problem of air circulation without drafts and the quieting of occupational room noises, has been devised by the C. F. Burgess Laboratories, Inc.

This system comprises a perforated ceiling made of a suitable architectural surface installed slightly below the normal ceiling level of the room. Between the perforated sheet and the room ceiling is a sound-absorbing material that is installed with sufficient clearance so that a space is provided between this sound-absorbing material and the ceiling. This space provides a plenum chamber into which air is introduced through ducts from the ventilating fan. A uniform, low static pressure is maintained in this plenum chamber and suitable means are provided to cause the air to pass to the underside of the sound-absorbing material without passing through it, and thence through the myriads of small openings in the perforated sub-ceiling into the room.




A typical installation of Acousti-Vent. (1) Perforated ceiling. (2)




Side elevation showing plenum chambers and Acousti-Vent ceiling

Air flows imperceptibly and uniformly through the perforated ceiling into every part of the room, affording accurate temperature control. Tests indicate that there is no appreciable temperature variation throughout the room. Due to the large ceiling area and the low air velocity at every point, the Acousti-Vent system makes possible a rapid change of heated or cooled air without drafts, a feat not possible when air is forced into a room at concentrated points through conventional duct systems.

The second major feature of the Acousti-Vent system is its high efficiency as a sound absorbent. Room noises, upon reaching the perforated metal ceiling, seep through the small perforations and encounter the resilient sound-absorbing material placed behind the perforations. These sound waves are instantly absorbed, causing a marked reduction in the noise level of the room. In addition to absorbing room noises, Burgess Acousti-Vent also absorbs the noises of the ventilating system.

### COPPER IMPROVES LEAD

ADDING 0.06 percent of copper to common lead improves its physical characteristics and its resistance to general corrosion.—*D. H. K.*

### NO CHANCE?

HORATIO ALGER made a name for himself by writing books about something that is peculiarly American—the fact that every man in this country has a chance to win fame and fortune no matter what his start in life. In recent years, however, a lot of malcontents and demagogues have been taking advantage of the depression to insist that all that is changed.

The facts are that the depression slowed up the speed with which everybody was getting ahead. But something that happened in West Virginia the other day shows that the country of which Horatio Alger wrote still exists.

Twenty-two years ago, a lad of 15 went to work at the bottom of the ladder in the Carnegie Steel Company plant at Sharon,

aviator, and afterward for a time traveled around as a "barnstorming" stunt flier.

Later, this same lad, then a young man, worked as a mechanic, a riveter, and a salesman. In 1925, he joined the Weirton Steel Company as a salesman. In January, 1929, he became assistant sales manager; in May, 1931, he was appointed assistant to the President, and in July, 1934, he was elected a vice-president.

The other day, the Weirton Steel Company elected that same man as its President—T. E. Millsop. He probably is, at 37, the youngest high executive in the steel industry.

His start from scratch, and his rise to the presidency of one of the biggest steel companies in the land is just one of thousands of similar cases. But the malcontents and demagogues cannot afford to admit it for such an admission would make their arguments look as silly as they are.—*Industry.*

## Hardened Copper

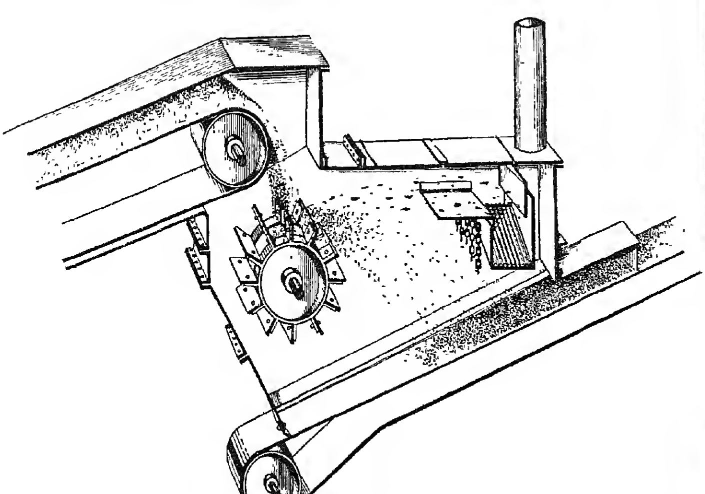
A COPPER alloy containing about 2 percent of chromium when properly heat-treated has a highly increased strength and hardness, yet retains 80 to 90 percent of the heat conductivity of pure copper.—*D.H.K.*

## Aerating, Separating Foundry Sand

ANNOUNCEMENT of a new foundry sand preparation unit, to be known as the "Sep-Aerator" because it performs automatically the two-fold function of (1), properly aerating and mixing the sand before delivery to molder's hoppers, and, (2), separating from the sand, such shot metal, pebbles, and small refuse as may not have been caught by screen or magnetic pulley, has been made by Link-Belt Company. This separating feature is of particular value in non-ferrous foundries, where it is not possible to remove metallic shot by magnetic attraction.

The operating principle is illustrated in one of our drawings, which also shows that the unit is one of few parts—a power-driven paddle-type beater, with sand and refuse collecting and discharging media, all enclosed within a steel housing, which is fitted with an air-release pipe and other suitable means for preventing any blast of air along the belt conveyor which receives and carries the aerated sand away from underneath the machine, to the respective molder's storage hoppers.

The position of the beater shaft—with its paddles which throw material according to weight—can be adjusted horizontally as required to give proper control of direction of the sand stream. After the beater shaft has been correctly located, the flow-regulating plate is adjusted to split the stream of sand and refuse at the desired point.



## Insects Live Foodless for a Year

INSECTS can live incredibly long periods without food, according to the American Institute of Sanitation, New York City. In an experiment to determine the endurance powers of insects, an entomologist kept bedbugs alive and fairly active for one year without any food whatsoever, reports the institute.

"This remarkable vitality probably explains the great prevalence of bedbugs, or red rovers as they are sometimes called," continued the institute. "In unoccupied houses the insects can exist for months. It would be no great feat for one to creep into a church pew on Sunday, for example, and then journey to a new home a week or two later, fasting during the interval.

"Not only do bedbugs have great fasting powers, but they are probably the most traveled of all the wingless household pests. Many a neat housewife is amazed at the occasional invasions of her home. Yet investigations of entomologists have disclosed that the insects easily enter the home in the laundry, packages from the store, and on the clothing of members of the family. Favorite gathering places for bedbugs are theaters, especially those with upholstered seats. All the large hotels are forced to maintain staffs to keep the pests under control. Sleeping cars on railroads are regularly treated to combat the insects.

"No home is immune from invasion of the pests, but no neat housewife need board them for long," continues the institute. "Modern science has perfected efficient powders, sprays, and liquids to combat red rovers. If such weapons are used both as a preventive and a cure, the careful housewife need have little fear of the pests.

"Although called bedbugs, they do not



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all live in beds. Very frequently the largest nests will be found under loose edges of wall paper, under the molding, behind pictures, and in cracks in the floor. Such hide-outs should receive attention when fighting the pests."

## A Captive Balloon Network

IT IS impossible, unfortunately, to avoid giving prominence to military aeronautics, with rumors of wars so frequent and persistent. Now that bombers seem to be in the ascendancy, both the British and the French are seeking every possible means of protecting their cities, and both nations are investigating the possibility of a defensive network of cables to be suspended from captive balloons. Such a network would consist of some 30 cables, strung a few yards apart and held aloft by captive balloons. Cables would also be strung one under the other, forming a species of wall in the air. Of course, the chance of the enemy running into the cables is small, but it would give the pilots something else to worry about, and force them to fly at higher altitudes. We seem to remember that a similar device was under consideration by the British during the World War.—*A.K.*

## Long-Wearing Bearing Metal

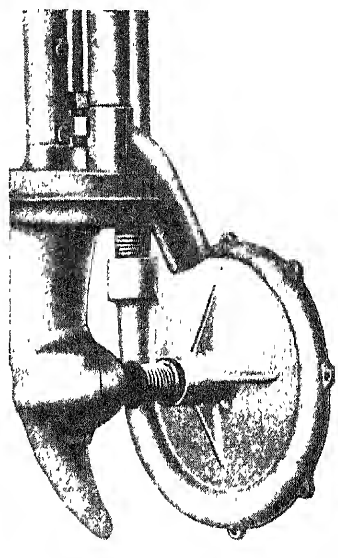
A NEW alloy automobile bearing which will outlast the best babbitt metal bearings now in use three to one times was announced at the opening session of the National Metal Congress. The new long-wearing alloy, according to *Science Service*, is a mixture of cadmium, silver, and copper. It was described by C. F. Smart, metallurgist of the Pontiac Motor Company. Used as bearing material in motor cars, the alloy outlasted babbitt bearings three to one under the most severe driving test conditions. Two things only check immediate adoption of the new alloy, Mr. Smart indicated.

Since the alloy contains silver and cadmium, its price changes with the prices of these metals. Cadmium, which sold for years at 55 cents a pound, has now jumped to a dollar a pound because of the demand for the metal in bearings. Future technological developments and a reduction of the use of cadmium in a number of plating processes are expected to lower the price of the metal in the future.

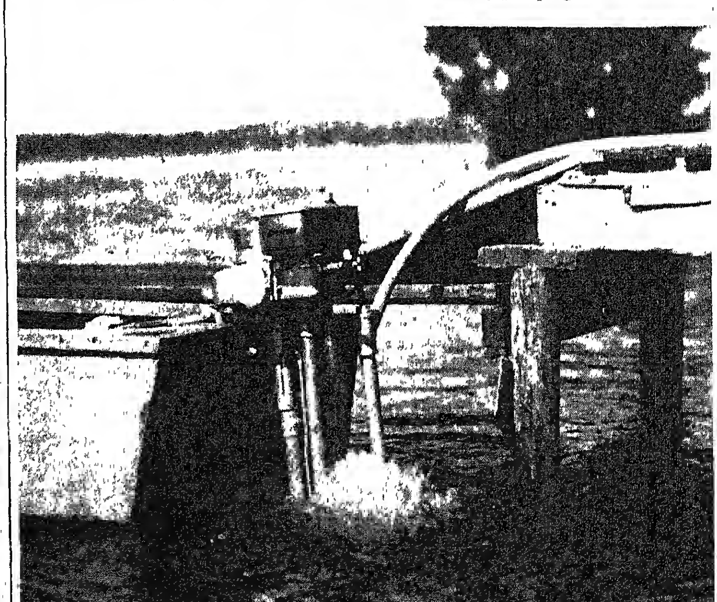
A second factor preventing immediate use is corrosion caused by organic acids in lubricants. Excellent co-operation is now under way, indicated Mr. Smart, between the petroleum and automobile industries to iron out this difficulty.

## Outboard Motor Drives a Pump

ATTACHED in a jiffy to the propeller shaft of an outboard motor, a compact, foolproof, centrifugal pump supplies cottage, garden, lawn, and so on, with an adequate water supply. The smallest single-cylinder outboards supply a full stream through a single hose as much as 250 feet long. Small twin motors will handle two streams. An old barrel, elevated for a grav-



*Above:* Pump attached to the lower unit of an outboard motor. *Below:* The motor, attached to the stern of a boat, pumping water ashore



ity supply system, can be filled rapidly and provides excellent fire protection.

Converting the outboard for temporary pumping enables the owner to salvage the "extra life" of the engine while it is not in boating use. The cost of these pumps is low.

## Polymolecular Films and a New Apparatus

REMARKABLE characteristics of oil films in water are revealed by a newly developed apparatus of high accuracy. This has been used by Harkins and Myers of the University of Chicago to trace for the first time how a film one molecule thick, or about 1/30,000,000 of an inch in thickness, can be changed into a liquid in bulk.

Certain oils of vegetable or animal origin spread on a clear water surface to a film one molecule thick, while a pure mineral oil will not spread at all. A small amount of vegetable or animal oil, added to a pure mineral oil, causes the oil to adhere much better to steel and thus improves greatly the lubricating characteristics of the oil.

Such mixtures have a wide use in the lubrication of automobiles. It is just such mixtures which have been found to give rise to films more than one molecule thick: that is, to polymolecular films.

That such films can exist is contrary to the theories held by workers in surface chemistry, but that they are easily formed is now proved.

One ounce of certain vegetable oils will spread over and cover completely three and one half acres of water surface with a lightly packed oil film one molecule thick. The molecules are held together in the film by their attraction for each other, or by cohesion.

If the oil molecules are shorter, they attract each other less and also vibrate more rapidly and the result is that one ounce of oil will now cover completely eight acres. This is called the expanded state of the film.

In the tightly packed film the molecules stand upright like the people in a tightly packed crowd: in the expanded state the molecules lean over and occupy more room. Other types of molecules lie flat on the surface, so that in a tightly packed film one ounce of oil covers 15 acres, and in an expanded state will cover about 20 acres of water.

The characteristics of films are of great importance in connection with the manufacture of paints and of laminated glass, in color printing, in the flotation of ores, and in many other industries, and especially in biology and medicine.

## Smooth Belt Joints

A NEW non-metallic belt lacing, Tek-Lace, gives the safety, efficiency, and durability of endless belting, plus the convenience, low cost, and ease of application of ordinary belt fastenings. It is used for fastening flat belts or V-belts.

Made of the strongest fibers known—raw silk, finished with a special twist, a special impregnation, and a special surface coating—Tek-Lace is only 0.055 inches in diameter, but has a tensile strength of 100 pounds. This is more than 50 percent stronger than Federal specifications for rawhide ¼" wide and ⅛" thick. A three-inch belt fastened with Tek-Lace has a tensile strength of 2000 pounds at the joint. The small holes that it requires are pierced through the belting without cutting the belt fibers, thus avoiding weakening of the belt itself.

The efficiency of this lacing is due to its flexibility and the fact that it sets into the belt instead of standing out above the surface, resulting in a smooth joint.

# CURRENT BULLETIN BRIEFS

*(Bulletins listed as being obtainable through Scientific American can be supplied only by mail)*

MINERAL RESOURCES OF THE REGION AROUND BOULDER DAM. An appraisal of the mineral resources of the region with respect to their probable availability as the basis of industries that would consume power generated at Boulder Dam. United States Geological Survey Bulletin 871. *Superintendent of Documents, Washington, D. C.—45 cents (coin).*

TAKING PICTURES AT NIGHT will serve to guide the amateur photographer in the use of proper exposure for outdoor scenes after dark and for theater photography. Several excellent examples are given, together with information as to how the photographs were taken. *American Photographic Publishing Co., 428 Newbury Street, Boston, Massachusetts.—40c postpaid.*

THE NEW ARC WELDING TECHNIQUE describes in text and photographs various types of arc welding equipment and accessories, together with specific applications. It gives a technical description of the new type of welding control. Write for *Bulletin 237A, Scientific American, 24 West 40th*

BULLETIN OF THE TEXAS ARCHEOLOGICAL AND PALEONTOLOGICAL SOCIETY. Eighth annual bulletin of an association of amateur archeologists which has earned a place close to the borders of professional work. Illustrated, 200-page paper-covered book describing finds in Texas. *Dr. Cyrus N. Ray, Box 594, Abilene, Texas.—$3.00.*

ARTESIAN WATER IN THE FLORIDA PENINSULA (Water-Supply Paper 773-C, U. S. Geological Survey), by V. T. Stringfield. Readers desiring to understand the geology and hydrology surrounding the proposed Florida ship canal will find it here—without any reference, however, to the canal question. *Superintendent of Documents, Washington, D. C., 20 cents, cash.*

THE SHORTAGE OF WATERFOWL, by Ellsworth D. Lumley, is Publication No. 58 of the Conservation Series issued by The Emergency Conservation Committee. This eighteen-page pamphlet is devoted to a discussion of the problem in an attempt to come to a satisfactory solution, to suggest possible methods of saving our waterfowl, and to

ship. It is expressly prepared for use in schools and colleges but will interest every lover of wild life. *Emergency Conservation Committee, 734 Lexington Avenue, New York.—Single copies 10c each; 12 copies for $1.00; 100 copies for $7.50.*

THE BRITISH RAILWAYS, by Alex. Newlands, is a book of 134 pages with stiff board covers that tells in considerable detail the story of transportation from the days of the pre-historic highways—mere paths—through the Roman roads and canals, to the railways of today and tomorrow. *Longmans, Green and Co., 114 Fifth Avenue, New York City.—$3.15 postpaid.*

KITCHEN TEMPERATURES, by Anne Pierce, tells the story of controlled heat and cold and their contribution to kitchen efficiency and comfort. It also gives many hints as to the proper arrangement and use of kitchen equipment. *The Temperature Research Foundation of Kelvinator Corporation, 420 Lexington Avenue, N. Y. C.—Gratis.*

EXCLUDING BIRDS FROM RESERVOIRS AND FISHPONDS deals with a problem that besets everyone who endeavors to raise fish in either large or small outdoor ponds. Illustrated with photographs and drawings. *Superintendent of Documents, Government Printing Office, Washington, D. C.—5 cents.*

THE ORIENTAL INSTITUTE OF THE UNIVERSITY OF CHICAGO is an illustrated handbook describing the scope, purpose, and history, as well as the field work of a noted archeological institution which maintains several expeditions in the Near East.—*The Oriental Institute, University of Chicago, Chicago, Ill.—35 cents.*

UNITED STATES SECTIONAL AERONAUTICAL CHARTS now cover the entire United States. Each of the charts is approximately 40 by 20 inches in size, representing an area about 300 miles by 150 miles. They are designed especially for cross-country air navigation. For details and finding sheet address the *Director, Coast and Geodetic Survey, Department of Commerce, Washington, D. C.*

PONTALITE is a small 16-page folder that gives the physical, thermal, and other properties of a new plastic material for industrial use. Among other desirable qualities, Pontalite can be obtained in a form as clear as glass or in various colors. *Write for Bulletin 237B, Scientific American, 24 West 40th Street, New York City.—3 cents.*

AMERICAN PLANNING AND CIVIC ANNUAL is in reality two books bound in one set of board covers. The first section, 248 pages, gives a record of recent civic advances. The second section, 170 pages, deals with planning for city, state, region, and nation-wide civic progress. *American Planning and Civic Association, 901 Union Trust Building, Washington, D. C.—$3.00.*

PICTOGRAPHS AND PETROGLYPHS OF THE HIGH WESTERN PLAINS, by Prof. E. B. Renaud. A book concerning Indian pictographs, their nature, meaning, age, location, and so on, in the regions of Colorado, Wyoming, South Dakota, and New Mexico, general information on this subject. *Department of Anthropology, University of Denver, Denver, Colorado.—75 cents.*

SUBGRADE DRAINAGE FOR MODERN ROADWAYS deals with the necessity for and methods of obtaining a dry, stable subgrade. A number of photographs and comprehensive drawings illustrate the 32 pages of text. *Armco Culvert Manufacturers Association, Middletown, Ohio.—Gratis.*

A HISTORY OF THE NEW YORK STATE COLLEGE OF FORESTRY AT SYRACUSE UNIVERSITY, in 176 pages plus a map of New York State, outlines in detail the history and present activities of the college. *The New York State College of Forestry, Syracuse University, Syracuse, New York.—$1.00.*

TRAPSHOOTING HINTS gives information of value to shotgun shooters who are striving to improve their scores. 32 pages of suggestions by experts. *E. I. du Pont de Nemours & Company, Inc., Wilmington, Delaware.—Gratis.*

HOMES OF ENDURING BEAUTY BY WEATHERBEST deals specifically with the use of stained shingles for homes. Shingles, when properly stained, have excellent weathering qualities and keep their pleasing appearance even after long years of use. The booklet gives many illustrations of shingled homes and describes several stains and opaque coatings for exterior use. *Write for Bulletin 237C, Scientific American, 24 West 40th Street, New York City.—3 cents.*

9-INCH WORKSHOP PRECISION LATHE CATALOG contains over 150 illustrations showing new styles, features, and applications of an up-to-date back-geared, screw-cutting lathe particularly designed for the home workshop. *The Technical Service Department, South Bend Lathe Works, South Bend, Ind.—Gratis.*

DIRECTORY OF AMERICAN MINERAL AND GEM COLLECTORS AND COLLECTIONS, by Wm. C. McKinley. The names and addresses of the followers of a growing hobby. *Wm. C. McKinley, 730-B 4th Street, Peoria, Ill.—10 cents.*

RAILWAY TRACK GRINDING describes and illustrates methods of reconditioning railroad tracks so that they give the best possible service. It covers, first, building up of worn rail ends by welding, and then describes the use of grinding equipment to produce a perfect finish. *Write for Bulletin 237D, Scientific American, 24 West 40th Street, New York City.—3 cents.*

MACHINE-MADE JOBS deals with the subject of "technological unemployment" from a calm viewpoint that considers only facts and leaves emotion to those who attack the machine as a cause of unemployment. *Machinery and Allied Products Institute, 221 North La Salle Street, Chicago, Illinois.—Gratis.*

RAIL SERVICE AND ITS COST is an eight-page pamphlet specifically addressed to farmers who have a definite interest in cheaper transportation for their products. *Association of American Railroads, Transportation*

# LEGAL HIGH-LIGHTS

## Patent, Trademark, and Related Legal Proceedings That May Have a Direct Effect on Your Business

By ORSON D. MUNN, Litt.B., LL.B., Sc.D.
New York Bar
Editor, Scientific American

### WHOSE NAME?

YOUR right to use your own name is not without legal limitations. Thus if your name has been used as a trade name or as a trade mark for an article of commerce and has become well known as such (for example, Waterman and his famous ink), you can not use your name on a competing product without taking reasonable precautions to disassociate your product from your illustrious protonym.

A hat manufacturer whose hat bears a name which has become indelibly associated with men's hats, recently brought suit against a competitor having the same surname but a different given name. The competitor used his full name, that is, given name, surname and middle initial, in association with his product. However, the Court said that the surname had become so well known to the public in the manufacture and sale of hats that it had acquired a secondary meaning and that it was necessary for the competitor, who was a newcomer in the field, to distinguish his product from the original seller of hats bearing that surname. The mere use of the given name and middle initial of the competitor was held to be insufficient to properly distinguish his product. In reaching this conclusion the Court made the following statement:

"We do not understand that the right to use one's own name is absolute unless fraud is consciously planned. A newcomer whose name will cause the public to confuse his product with that of an established competitor may be required 'to take reasonable precautions to prevent the mistake.'"

### PAPER PATENTS

THE patent statutes of the United States do not discriminate in any way between those patents which go into commercial use and those which, for one reason or another, are never commercially exploited. It is the policy of the patent laws of many countries to penalize patentees who do not exploit their inventions. Thus some countries have provisions whereby a compulsory license can be secured if a patented invention is not exploited within the country within a fixed time limit. Other countries have provisions whereby a patent may become forfeited or may be cancelled if it is not commercially exploited.

The policy of penalizing a patentee who does not exploit his invention has not been incorporated in the United States patent statutes. As a practical matter, however, the Courts, in suits for patent infringement, distinguish between those patents which have never been commercially utilized). In a recent case in the Circuit Court of Appeals for the Third Circuit, the attitude of the Courts towards paper patents was clearly stated as follows:

"It (the patent) is now over nine years old and is still a mere paper patent. It is accordingly entitled only to a strict construction confining its scope to the particular device disclosed."

The policy of the Courts is to construe strictly those patents which have not gone into use and, on the other hand, to give a more liberal interpretation to those patents which have met with great commercial success. This attitude is both fair and logical because it is reasonable to assume that those patents which have met with commercial success are based on inventions of great merit, while those which have not gone into commercial use in all probability relate to inventions that have considerably lesser merit.

### PRICE FIXING

THE American law has been traditionally opposed to any attempts to fix the selling price of articles of commerce. Accordingly, the recent unanimous decision of the United States Supreme Court upholding the so-called fair trade or price fixing law of the State of Illinois is of great importance.

The Illinois statute purports to legalize contracts for the sale or resale of commodities identified by the trade mark, brand, or name of the producer or owner, notwithstanding that such contracts provide that the buyer should resell at a price stipulated by the vendor, and that the vendee of such a commodity in turn shall require, upon the sale to another, that the purchaser agree to resell at a price that is fixed by the vendor.

The statute further provides that willfully and knowingly advertising, offering for sale, or selling of any commodity at less than the stipulated price, is an act of unfair competition.

The decision of the Supreme Court was rendered in two suits for unfair competition, in which it was alleged that retail liquor stores had sold commodities identified by the trade mark of the producer at prices lower than those stipulated by the producer. The retail liquor dealers contended that the Illinois statute was in violation of the Fourteenth Amendment of the United States Constitution. The Supreme Court rejected this argument and sustained the statute.

About one year ago the New York State Court of Appeals decided that certain provisions ... It will be very interesting to see whether the New York State Courts change their attitude in view of the decision of the Supreme Court.

One point which has not been definitely decided by the Supreme Court decision is the validity of contracts made under such fair trade statutes which attempt to fix the resale price of trade marked articles sold in interstate commerce. Price fixing contracts affecting interstate commerce have heretofore been held to be in violation of the Sherman Anti-Trust Law. The State Legislatures can not, of course, legislate with regard to interstate commerce. Regardless of this, however, statutes such as this should prove to be an effective instrument in eliminating price cutting and in stabilizing prices.

### FLEXIBLE 17 YEARS

A PATENT purports to confer upon the patentee the exclusive right for 17 years to manufacture, use, and sell the article, machine, or method covered by the patent. The owner of the patent, however, may inadvertently curtail the effective life of the patent. Thus where the owner of a patent fails to take action against an infringer and tacitly permits him to infringe the patent for many years and build up a large business in the patented product, he can not enforce the patent against that infringer.

In a case involving patents relating to shoe manufacture, the owner of the patents failed to take action against the infringer for a period of over eight years and knowingly permitted him to build up a large business based on the patented invention. Because of this delay the Court refused to grant relief to the owner of the patents, stating:

"For a period of eight years defendant and its predecessor were lulled into security by plaintiff's failure to sue. Plaintiff has failed to give satisfactory explanation of its inaction. At this late date after defendant's investment it is inequitable that defendant should be called to account."

### A ROSE BY ANY OTHER NAME

CAN any one secure a legally protected monopoly on an odor? Hardly. However, in suits for unfair competition one of the elements which the Court may take into consideration in deciding whether a manufacturer has too closely simulated the merchandise and packaging of a competitor is the similarity in odor of the competing products.

In a recent case in the United States District Court for the District of New Jersey, a manufacturer of a rather well known hair tonic alleged that a competitor was unfairly competing with him in selling a product which simulated his hair tonic too closely. In reaching a decision the Court stated that it was necessary, among other things, to take into consideration the respective odors of the competing hair tonics. In this connection the Court stated as follows:

"Plaintiff's right to relief depends upon a combination of factors in which color, odor, bottle, and label play a part, and they must be so combined by a competitor as

# Books SELECTED BY THE EDITORS

### THE ART OF CONVERSATION

*By Milton Wright*

WHILE there are many who don't get ahead because they talk too much, millions feel inferior because they are inarticulate, or are inarticulate because they feel inferior. The author of this helpful book, a former member of the staff of this magazine, is a perfect conversationalist, and he tells others in a practical way how to learn to appear equally intelligent. "Getting Started," "Just the Two of You," "When the Talk is General," "Developing Repartee," "How to Tell a Story," "Learning to be Tactful"—these are some of the aspects of the art of conversation he deals with. No doubt this book would help some of the dumb-struck to break the jinx of their troubles and cause the full current of their lives to flow ahead.—$2.65 postpaid.—*A. G. I.*

### ENGINEERING AERODYNAMICS

*(Revised Edition)*

*By Lieutenant Commander Walter Stuart Diehl*

WHEN "Engineering Aerodynamics" appeared in its first edition it immediately became the standard source of reference for practicing aeronautical engineers and students alike. The revised edition undoubtedly will have the same successful reception. A vast, almost overwhelming body of aerodynamic knowledge has become available as a result of wind tunnel studies and airplane construction. Commander Diehl's task for many years in the Bureau of Aerodynamics has been to reduce such knowledge to the practical service of design engineers and his book renders the same service admirably to a far wider circle. The reader is not burdened with abstruse theories (although fundamental principles are clearly set forth) but given the most up to date, complete and reliable information on applied aerodynamics in such form as to make it immediately utilizable. An altogether admirable text, which is further enhanced by numerous references and a fine index.—$7.25 postpaid.—*A. K.*

### PICTORIAL LIGHTING

*By William Mortensen*

IT has been a long step from the original uncontrolled light of the sun used by the first photographers to the intense and controllable lighting of the present fundamentals of controlled lighting for the photographer and numerous photographs and drawings showing how to achieve certain effects.—$2.15 postpaid. —*A. P. P.*

### THE NEW MAGICIAN'S MANUAL

*By Walter B. Gibson*

IF YOU are one of those people who would like to shoot "the life of the party" for monopolizing the attention of everyone, do all you can to prevent him from getting a copy of this excellent book. It would make him too insufferably clever. Better yet—get a copy yourself and beat him at his own game. This manual is a unique guide to parlor magic, containing complete and easily followed instructions for over 100 mystifying tricks. Furthermore, it contains the actual apparatus (in a bound-in envelope) required to do these tricks. In addition, there are programs and routines for the budding magician and samples of patter for those who are tongue-tied.—$3.25 postpaid.—*F. D. M.*

### THE RENAISSANCE OF PHYSICS

*By Karl K. Darrow, Ph.D., Research Physicist, Bell Telephone Laboratories*

DARROW'S abilities as a popular writer are widely recognized. His is an unusually lucid style. In this book he discusses atomic physics: structure of the atom, mystery of waves and corpuscles, transmutation, victory over the elements, and the unity of nature. Readers who find that some of the popular attempts to render these subjects perfectly simple are a bit empty will like this book better, for it has quite a lot of substance to it.—$3.15 postpaid.—*A. G. I.*

### THE RIDDLE OF WOMAN

*By Dr. Joseph Tenenbaum*

THIS is a scientific book but it manages to include plenty of things that make interesting reading on their own account—if you get what is meant! But it is not one of the many extant "dirt" books which are deliberately labeled "scientific" only in order to get by various censors, including the one in the purchaser's mind. The office speaker-out-of-turn calls it "a scientific book that isn't soporific." Here are some of the chapter heads: Woman's Sex Psychology; Sex Urge in Woman; The Wife; The Bride; The Unmarried Wife; The Virgin; The Spinster; The Psychology of Woman; The Angel, Gossip, Criminal; Witch; The Beautiful Woman; The Prostitute. Total, 465 pages. The author's point of view is somewhat more cynical, realistic, and pragmatic than idealistic and emotional or traditional. But, even after reading the whole book, this reviewer still doesn't understand women.—$3.70 postpaid.—*A. G. I.*

### SECRET WRITING

*By Henry Lysing*

NO more can be said about this book than that it provides for code addicts a vast array of cryptograms, codes, and other methods of concealing the actual meaning of written words. 118 pages of compact information.—$1.15 postpaid.—*A. P. P.*

### RICH LAND, POOR LAND

*By Stuart Chase*

A STUDY of waste in the natural resources of America, which has been well received by most scientists who deal with this field of work, even though some aspects of it involve planned economy, the TVA and other things concerning which 26,000,000 of us sometimes disagree with 16,000,000 of us. Whether we agree on these factors, all do agree that our soil is our fundamental source of wealth, and that we shall be fools if we let it go to ruin. Mainly this book is a study of basics regarding which most of us will agree to agree.—$2.65 postpaid.—*A. G. I.*

### HOW TO WRITE A MOVIE

*By Arthur L. Gale, Editor of "Movie Makers"*

OWNERS of amateur motion picture cameras all too frequently fail to get the most out of their chosen hobby because they do not know how to prepare a simplified motion picture scenario which will enable them to produce films that have lasting interest. In this book of 199 pages, including an index, the author has cleared the way and tells simply and concisely just how to proceed.—$2.15 postpaid.—*A. P. P.*

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NINETY-THIRD YEAR • ORSON D. MUNN, Editor

## CONTENTS · MARCH · 1937



STEGOSAURUS, the 20-foot "pin-headed" dinosaur of the Age of Reptiles, from about 100,000,000 to about 200,000,000 years ago, had in its head a brain that weighed but 2½ ounces, and in its rear part a second brain! On its back were sharp plates of bone two feet high, for defense, and on its tail six heavy spines. This and all the great dinosaurs described by the zoologist, Roy Chapman Andrews, in the leading article of this number became wholly extinct roughly 99,000,000 years before man evolved.

## The SCIENTIFIC AMERICAN DIGEST



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# 50 YEARS AGO IN . . .

SCIENTIFIC AMERICAN

*(Condensed From Issues of March, 1887)*

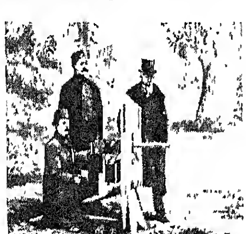
TELEPHONE INFECTION—"At a meeting of the Caucasian *Medical Society, Dr. A. P. Astvatzaturoff,* of Tiflis, drew attention . . . to the danger of infection arising from the promiscuous use of the mouthpieces of public telephones. To prevent any accident of the kind, he recommends that the mouthpiece should be disinfected every time after, or, still better, before it is used."

FORTS—"Sir Henry Bessemer proposes to obviate the enormous expense of ordinary armor plates for forts by casting *in situ* the whole face of a fort or complete turret in one solid piece of steel, with all its ports and loop-holes properly shaped and formed in the act of casting."

WHALES—(It has been calculated that) "a whale 80 ft. long, weighing about 74 tons, and with a tail 18 ft. to 20 ft. across from the extreme ends of its flanges would require to exercise a propelling force of 145 horse power to reach a speed of twelve miles per hour."

ELECTRIC LIGHT—"The question as to electric lighting popularity has always been one of economy. No one ever doubted that electric lighting would be popular, but many did doubt if it would ever be cheap enough to be generally used. . . . To-day the cost of an electric lighting plant is less than one-half what it was six years ago, and there is every reason to believe that six years from now almost an equal decrease in cost will have been attained."

MACHINE GUN—"Mr. Henry M. Stanley was compelled, a short time ago, to abandon his lecturing tour through this country, and was recalled to take command of an expedition in relief of Emin Pasha. . . . Before leaving England he provided himself with one of Mr. Hiram S. Maxim's automatic machine guns, and the illustration, which is taken from a photograph, represents the great explorer in the act of firing the gun, while our compatriot, the inventor, is standing immediately behind the gun. . . . The action of the gun is automatic, each cartridge being discharged by the recoil of the shot preceding. The cartridges are placed in a belt, and the empty shells are thrown out in front of the gun, as shown in the photograph. The rate of fire is about 600 times a minute. With the shorter and smaller cartridges, such as are used in the U. S. army, the rate of firing would be about 700 shots a minute."



ELECTRIC RAILWAYS—"The Van Depoele electric street railways seem to be taking the lead in this country, being now in operation, with much success, in the following places: Minneapolis, Minn., Montgomery, Ala., Detroit, Mich., Appleton, Mich., Port Huron, Mich., Scranton, Pa.; also in Toronto and Windsor, Canada. In a short time the company will have electric cars running in Lima, O., and Binghamton, N. Y. More miles of electric railways on this system are now at work than all other systems put together."

PEPPER—"The substance known in the pepper trade as 'poivrette,' or 'pepperette,' is . . . frequently used for the purpose of 'fraudulently increasing the weight and bulk' of commercial pepper."

ATOMS—"Among the most interesting results of recent chemical investigation must rank our recognition of the fact that there exist certain so-called 'ring-shaped' groups of atoms, like those of benzol, naphthaline, anthracene, and pyridine, which are widely distributed and which are formed with exceptional readiness."

EPIORNIS—"The epiornis was probably a strictly terrestrial bird, incapable of flight. Nothing has been found to determine its conditions and way of existence, except some eggs and a few other semi-fossil remains . . . its remains occur in recent alluvial deposits, and from their recency are classified as sub-fossils. . . . Its egg is of gigantic size, as may be inferred from the cut. Its exact dimensions are given by De Chenu, in his 'Encyclopedie d'Histoire Naturelle,' Paris, 1875. Its largest diameter is 13.38 inches, its smallest diameter 8.86 inches. . . . The thickness of the shell is given by the same author as a little over one-tenth of an inch."

FARM—"In the extreme southwest corner of Louisiana lies the largest producing farm in the world. It runs 100 miles north and south, and many miles east and west, and is owned and operated by a syndicate of Northern capitalists."

UMBRELLAS—"Jonas Hanway introduced the umbrella into England more than a hundred years ago. The people all made fun of him, but maybe it was because they hadn't sense enough to get out of the wet when it rained. There are more than 7,000,000 umbrellas made every year in the United States."

PRESERVATION—"A novel and valuable application of photography has been made by the Century Company, combining the complete preservation of valuable copy against accidental loss or injury by fire or otherwise with the greatest convenience in storage and handling. Over 25,000 sheets of copy of a work on its way through the press, with interlineations, corrections, and additions, have been photographed on a reduced scale of only 1¾ x 2 in."

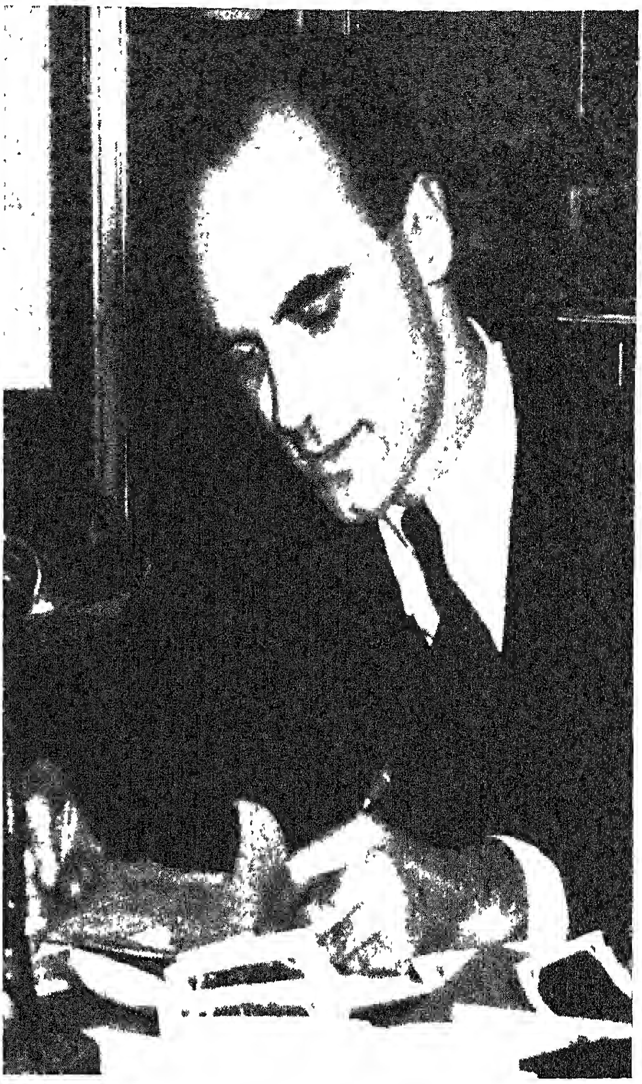
YELLOW PAPER—"The author contends that the yellowing of paper is due to an oxidation determined by light, and especially by the more refrangible rays. Dry air is another important condition for the preservation of paper. The author thinks that in libraries the electric light is inferior to gas, on account of the large proportion of the more refrangible rays present in the former."

PHOTOMICROGRAPHY—"The great value of isochromatic plates in microphotography (*sic*) has been demonstrated by Dr. Crookshank, who exhibited to the Royal Microscopical Society of London micro-photographs (*sic*) of bacteria obtained without staining the objects with aniline."

AND NOW FOR THE FUTURE

- **What is Life?, by T. Swann Harding**
- **Competition in Battleship Construction, by Walton L. Robinson**
- **Unscientific Measurement in Sports, by Prof. Paul Kirkpatrick**
- **Electro-Galvanizing—A New Technique in Metal Protection, by Philip H. Smith**
- **Immunity in the Witness Chair, By Clennie Bailey**

# *Personalities in Science*



CARL D. ANDERSON

AMERICA'S latest in Nobel Science Prize winners is quiet young Dr. Carl D. Anderson, Assistant Professor of Physics at the California Institute of Technology, Pasadena. He is an entire product of the California Institute curriculum, as he took his bachelor's and doctor's degrees there.

He further honors his Alma Mater by raising the number of Nobel Prize winners on her faculty to three. The other two are Dr. Robert A. Millikan, physicist, and Dr. Thomas Hunt Morgan, biologist-geneticist. No other educational institution in the United States has attained an equal record so far.

After receiving his Ph.D. in 1930, Dr. Anderson began at once the research project that was to bring him scientific fame. For some years, Dr. Millikan has conducted a strong program of cosmic ray research at the Norman Bridge Laboratory of Physics. Together, he and Anderson designed and constructed an apparatus for the purpose of investigating the properties of cosmic rays.

An adaption of the Wilson cloud chamber was used in conjunction with a huge electro-magnet to measure speeds and energies of particles ejected from the substance through which the cosmic rays passed. Electrically charged particles between magnetic poles move in curved rather than straight lines, and a measurement of the radius of curvature enables their speed to be calculated. With this apparatus they observed high-speed electrons, many of which showed a powerful electrical charge. Months were spent studying the properties of these positively charged particles. Then Anderson inserted a lead plate barrier into the cloud chamber. Measurement of the track of a particle before and after passing through the lead plate was calculated to give definite information about the particle mass and electron charge.

This arrangement proved fruitful. Anderson obtained a photograph in August 1932, showing a positively charged particle emerging with a lower energy after passing through the lead plate. Its path curved away from the regular paths of negatively charged particles! The conclusion was that this must be a *positive* electron. Further studies strengthened the interpretation that a *new kind of fundamental particle* had been located. The account is given at some length in the chapter on "The Positron," in Millikan's book, "Electrons (+ and —), Protons, Photons, Neutrons, and Cosmic Rays," and was described in Scientific American, August 1935, in a three-page article by Professor E. U. Condon of Princeton, where a photograph of the track of the positron was shown.

At the outset of this piece of research, such a discovery had not been anticipated. However, Dirac's brilliant electron-equation had predicted the possibility. The positron seemed to be the very particle corresponding to Dirac's "hole in space" hypothesis.

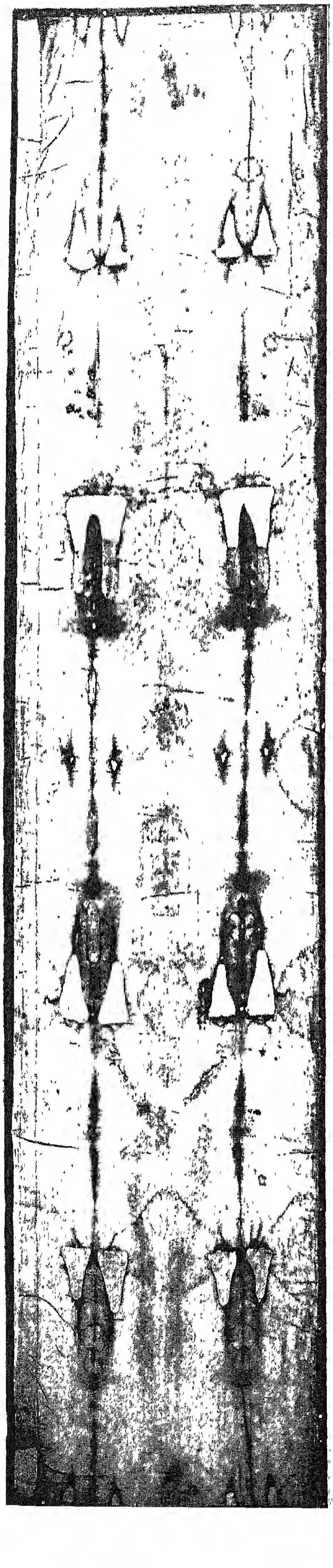
It is a noteworthy coincidence that Dirac, who mathematically anticipated the positron, and Anderson, who isolated it, were each 31 years of age when they received the Nobel award in recognition of their work. P. M. A. Dirac, well-known British scientist of Cambridge University, received the Nobel science award in 1933.

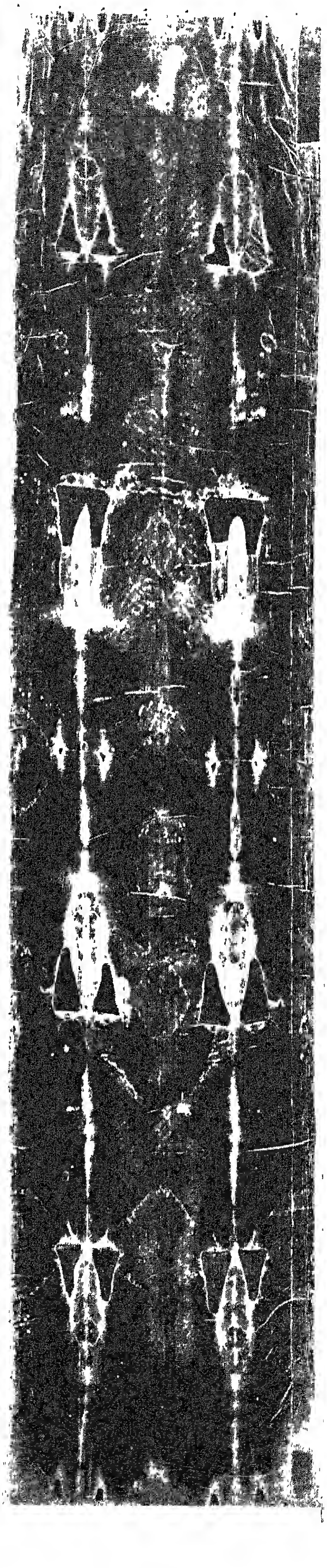
Dr. Anderson has made still further contributions to the study of cosmic radiation by his research on the energy spectrum of cosmic rays and their energy loss in passing through matter. In the summers of 1935 and 1936, he and Dr. S. H. Neddermeyer, a laboratory associate, took their elaborate apparatus to the top of Pike's Peak and to Panama. They obtained excellent photographs on these trips.

"I intend to continue in the same field," Dr. Anderson enthusiastically states. "There is still so much to be learned of nuclear physics."

This boyish looking young professor declares himself to be totally without hobbies, and insists that he doesn't do anything. But his very approachable manner brands him as one of the more human scientists.—*Susan Hartley.*

# An Intriguing Problem of Science and History





ON this page are two photographs which provide the subject of the article on page 162, by the biologist, Professor Vignon. The one at the left shows a 14-foot length of linen cloth on which are figures thought by some to be the imprints of Christ.

The hypothesis is that Christ, after prolonged suffering and death, was laid on one half of this linen and the other half was folded over lengthwise—note the corresponding, inverted figure of a back at the top. The figures have been explained by natural chemical causes. During intense suffering the perspiration contains increased amounts of urea. Later this breaks down into water plus ammonium carbonate, $(NH_4)_2CO_3$, the latter again breaking down and giving off the gas $NH_3$, ammonia. The linen Shroud was impregnated with powdered medical aloes (*Aloes socotrina*) used as a preservative. Ammonia reacts with this. Thus were produced the brown stains in the fabric. There is no pigment.

The left-hand illustration shows the Shroud as it actually appears. The black marks were caused by a fire which scorched the Shroud while folded. The white triangles are patches inserted where the Shroud was burned through.

The right-hand illustration is a reproduction of the *negative* of a photograph of the Shroud. Since the original figure is a negative, the negative of its photograph becomes a positive. Only with the age of photography has it been possible to bring out the much more vivid positive imprint which many believe to be Christ's.

Two problems involved are: First, is this the chemically produced imprint of a being? Second, a historical problem: Was that being Christ? Professor Vignon confines his article to these scientific aspects of the question.

From a painting given to the Field Museum of Natural History, Chicago, by Ernest R. Graham

*Figure 1: Brontosaurus* as depicted by the scientific artist Charles R. Knight after detailed study of the fossils

# CONSIDER THE DINOSAUR

## He Was Long of Body but Short of Intellect, and He Died Out—Just Why, We Do Not Know... There Were Dozens of Types of Dinosaurs...How We Know

By ROY CHAPMAN ANDREWS

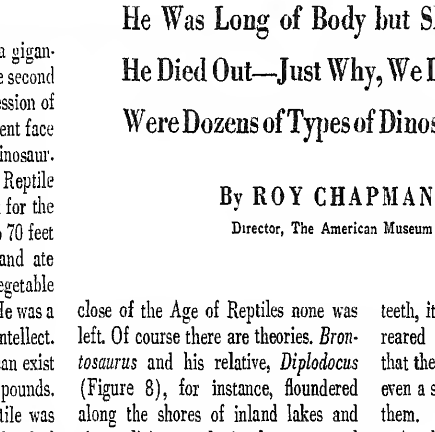
Director, The American Museum of Natural History

THE cartoonist's picture of a gigantic creature pecking into the second story window with an expression of expectancy on its rather benevolent face is the popular conception of a dinosaur. *Brontosaurus*, the Thunder Reptile (Figure 1), is the usual subject for the sketch. He was pretty big—65 to 70 feet long, weighed about 25 tons, and ate several hundred pounds of vegetable food each day if he could get it. He was a giant in size, but a pygmy in intellect. The smallest human brain that can exist with reasoning powers is two pounds. The brain of the Thunder Reptile was not much bigger than a man's clenched fist although the animal itself weighed more than 300 times as much as a man.

But *Brontosaurus*, although the most popular, was only one of the dinosaurs. The largest of all was the *Brachiosaurus* of Colorado and German East Africa, 100 feet in length; the smallest was hardly larger than a chicken, named *Anchisaurus* (Figure 3). Two years ago Dr. Barnum Brown discovered one in Montana about the size of a jack rabbit!

Some dinosaurs were plant eaters; others ate only flesh. Some lived on land; others in water. There were those that walked upright on two legs and dinosaurs that crawled on all fours. They dominated the earth during the Age of Reptiles in every continent.

We don't know why the dinosaurs disappeared, but the fact remains that at the close of the Age of Reptiles none was left. Of course there are theories. *Brontosaurus* and his relative, *Diplodocus* (Figure 8), for instance, floundered along the shores of inland lakes and rivers, living partly in the water and partly out. They had to find several hundred pounds of vegetable food a day to nourish their gigantic bodies. When the lakes dried up they died. They were too highly specialized to change their habits; too big to migrate. With their tons of flesh, small heads, and feeble teeth, it is obvious that they had been reared under such special conditions that they could not adapt themselves to even a slight change in the world about them.




From W. D. Matthew, "Dinosaurs"

*Figure 2:* Five of the dinosaurs drawn to the same scale, which is given by the topmost animal—about 65 feet

Another theory is that the dinosaurs exterminated themselves. Until the Central Asiatic Expeditions, under my leadership, discovered dinosaur eggs in the Gobi Desert, it was not known how dinosaurs reproduced themselves. Dinosaurs are reptiles and most living reptiles lay eggs although some few give birth to their young alive. It was always supposed that some, at least, of the many kinds of dinosaurs laid eggs, but in the hundreds of deposits of bones in various parts of the world no egg had ever been found. Strangely enough, right on top of the first nest of dinosaur eggs which we found in the Gobi lay the skeleton of a small dinosaur. It was only four feet long and toothless. There is every reason to believe that it lived by sucking the eggs of other dinosaurs. Possibly it was in the very act of digging up these eggs

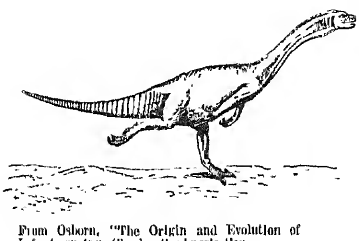
when it was overwhelmed by a sandstorm and was buried on top of the nest it had come to rob. This group of toothless dinosaurs may have become so numerous that they actually exterminated their relatives by eating the eggs as fast as they were laid.

The first mammals were tiny creatures not larger than a rat. Close to the spot where the first eggs were collected we found seven skulls and parts of skeletons of these little mammals. It is thought that these tiny mammals materially aided the toothless dinosaurs in their work of extermination by eating the eggs (Figure 6).

From the skeletons of many species of dinosaurs which are well preserved, it has been a simple matter for anatomists to model the flesh and give an accurate representation of the animals' appearance in life. Moreover, we know exactly what the skin was like of *Trachodon*, the Duck-Bill dinosaur (Figure 5). In the sandstone of Montana impressions of the skin have been found. These animals apparently died and shriveled up before decomposition set in. They were then covered with windblown sand or else were swept into water and overlaid with silt. The impression of the skin which consisted of small irregularly hexagonal horny scutes is perfectly preserved over much of the body.

THE great Duck-Bill was 25 feet long and stood 15 feet high. A thick, heavy tail helped to balance the huge body for the reptile walked on its hind feet; the fore limbs were much reduced. Widely distributed in Europe, Asia, and America, it fed on lush vegetation in a semitropical climate. We even know its food for the impressions of fossil plants have been found with the skeletons. Like many reptiles, living and extinct, he was continually renewing his teeth. As soon as one was worn out another took its place. In the upper and lower jaws there was a reserve supply of about one thousand teeth arranged in layers.

The greatest engine of destruction that has ever lived was *Tyrannosaurus rex*, King of Tyrant Reptiles (Figure 4). When standing erect on his two hind feet he was 18 feet high. The small fore limbs were equipped with enormous talons. The great mouth opened a yard wide and was armed with double-edged dagger-like teeth five inches long. Dr. Barnum Brown discovered a perfect skull of this huge beast and a fairly complete skeleton, which stands now in The



From Osborn, "The Origin and Evolution of Life," courtesy Charles Scribner's Sons

*Figure 3:* ***Anchisaurus,*** **smallest of the dinosaurs.** ***Brachisaurus,*** **largest, resembled** ***Brontosaurus***

American Museum of Natural History, dominating in death all the other huge creatures grouped about it, as it did in life. Its food was the flesh of other dinosaurs. We know that it and its smaller relative, *Allosaurus*, tore the flesh from the bodies of the mammoth *Brontosaurus* for in the Museum we have the skeleton of a Thunder Reptile plainly showing the teeth marks of these gigantic cannibals. I often stand beneath the skeleton of the Tyrant Reptile and let my imagination drift to those days in the far dim past when the world swarmed with these nightmare creatures. It has a strange fascination, that beast.

No other creature that lived was a match for the Tyrant Reptile, unless perhaps it was the three-horned *Triceratops* (Figure 4). He was a massive beast, 20 feet long, weighing perhaps 10 tons and with a skull which projected backward over the neck like a fireman's helmet. The neck, of course, is the most vulnerable point of almost any animal and when the *Triceratops* threw up his head, bringing into fighting position the three great horns, it also brought the helmet down on the neck covering it like a shield. Even the Tyrant Reptile would pause before launching itself on those murderous weapons reinforced by the defensive armor.

Certainly the most bizarre of all dinosaurs were the *Stegosaurs* or Plated Lizards [front cover.—*Ed.*]. They had tiny heads, heavy bodies, short legs, and long tails, armed on either side near the tip with two pairs of three-foot spines. From the end of the tail to the neck ran a series of large, thin, sharp-edged plates standing on edge. These plates are in pairs of approximately the same size but are placed alternately along the back, an arrangement not known to occur in any other animal. The ridiculous little head housed a brain so tiny that the creature must have had the absolute minimum of intelligence. The spinal cord doubtless took care of the mere mechanical functions of life. Moreover, in the sacral region the cord is enormously enlarged to a mass 20 times the size of the brain. When this discovery was announced by Professor Marsh news hawks immediately seized upon the idea that the animal had two brains: when the one in the head decided that it would like to move the body behind the pelvis it had to telegraph its desire to the "sacral brain" which then put the desire into action. It is an amusing suggestion which may have had some elements of truth.

DOZENS of other types of dinosaurs leaped or ran or waddled over the earth in the incredibly ancient period which is known as the Age of Reptiles. No geologist likes to state how many years ago that was. They prefer to say "it was a very, very long time," because the estimation of geological time even today is not exact enough to warrant positive statements. Yet it is a natural human desire to translate time into figures. For many years the estimation of geological time was based on the rate of deposition of sediments at certain specified places. For example, if it required 50 years for an inch of sediment to be laid down, by measuring the thickness of the sedimentary rocks an estimate was obtained of the number of years it re-

From a painting by Charles R. Knight, gift of Ernest R. Graham to Field Museum

*Figure 4:* **The ten-ton** ***Triceratops*** **(not related to the rhinoceros!) preparing for battle with** ***Tyrannosaurus rex***

quired to form those strata. But this was obviously an extremely unsatisfactory determination for deposition does not proceed at the same rate in different places or at all times. Based upon this method scientists believed that the whole history of life covered only about 40,000,000 years. No one could claim that this was more than an estimate, and a pretty unsatisfactory estimate at that, for it just didn't give time enough for the amazing changes in the life history of the earth which fossils revealed had taken place.

The modern criteria for the estimation of geological time are chemical. One of the most trustworthy is the radioactivity of igneous rocks.

With the discovery of radium 38 years ago, a real "clock" appeared which has yielded remarkable results. The atoms of radium, and its parent element uranium, are explosive, forming other elements, the last of which is lead. If lead and radium are found in the same rock you may be sure that the lead was produced by the radium. Knowing how long it takes a given quantity of radium to form a given quantity of lead, the age of a rock sample may be determined by the proportions of radium and lead which it contains. The earliest rocks measured by the radium time clock indicate approximately 2,000,000,000 years as the age of the oldest rocks. Probably life appeared about half a million years after the most ancient strata were laid down.

The dinosaurs, of course, did not develop until long after life had started on the earth and in its waters. The duration of the Age of Reptiles was about 110,000,000 years.

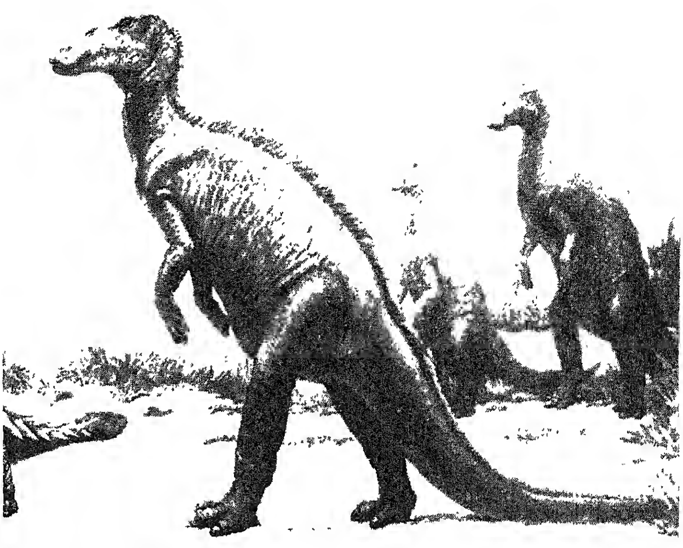


*Figure 5: Trachodon,* the Duck-Bill. Painting by Charles R. Knight, presented to the Field Museum of Natural History, Chicago, by Ernest R. Graham

THERE seems to be an idea that all a scientist needs is a single bone not only to build a skeleton but virtually to tell what the beast ate at his last meal. Certainly a good deal can be told from the teeth and from some bones, but it needs much more than that to reconstruct a skeleton. As a matter of fact, one usually works backward. Until more or less complete skeletons of dinosaurs representing different groups had been discovered it was impossible to do much reconstructing of imperfect specimens. Suppose part of a dinosaur's skeleton has been found. The first step is to determine what were its nearest relatives among the already known forms. Once that is done, because the general anatomical structure of related animals is similar, the skeleton can be assembled without much fear of wrong determinations except in details.

It is seldom that absolutely complete specimens are found. Some of the bones may have been dragged away by predatory animals; some may have been lost by water action if the beast died near a lake or was swept into a river; often many of the parts have been crushed by earth movements. If one is lucky enough to have a front and hind limb the missing ones may be reconstructed by copying those which were preserved. Often one side of a skull is more or less intact and the other side can thus be built up from the parts we have.

In the case of the *Baluchitherium* (Figure 7), a gigantic hornless rhinoceros which my expedition discovered in the Gobi Desert, the skull was in 600 pieces. Fortunately many of the massive parts were present and attached, thus giving a framework on which to build. Assembling those 600 fragments was exactly like doing a jigsaw puzzle. Bit by bit they were fitted together until all had been placed. But there were still gaps and these were modeled up to fit the general outline of the cranium. It took one man seven months to put that great skull together. But it was done so accurately that although two other skulls have since been discovered it has not been necessary to make more than minor readjustments in the original specimen.

Even if we have only a few teeth and some of the important bones there is still a great deal of general information about the animal that can be gained from their study. Leg bones are most often preserved, for they are heavier and less easily broken than other parts. If the bones are solid it means a sluggish creature or one of more or less aquatic habits. If they are hollow it indicates certainly an active land animal. If the hind legs are disproportionately long the inference is that the beast walked erect. Even one tooth will tell a lot. Certain kinds of food always demand definite tooth structure. A sharp-pointed or double-edged tooth could not be used for eating grass; therefore we know that the animal was carnivorous. A claw may give a definite hint. A blunt claw is decidedly not adapted for rending flesh; it suggests a creature with an herbivorous diet. If the claw is pointed downward it tells that in the living animal the sole of the foot was a thick, soft pad. Foot bones are among the most useful of all for giving hints as to the sort of animal that wore them, while vertebrae and ribs are of but comparatively little help as story-tellers or in determining the relation to living or known forms.

Such great collections of fossils now

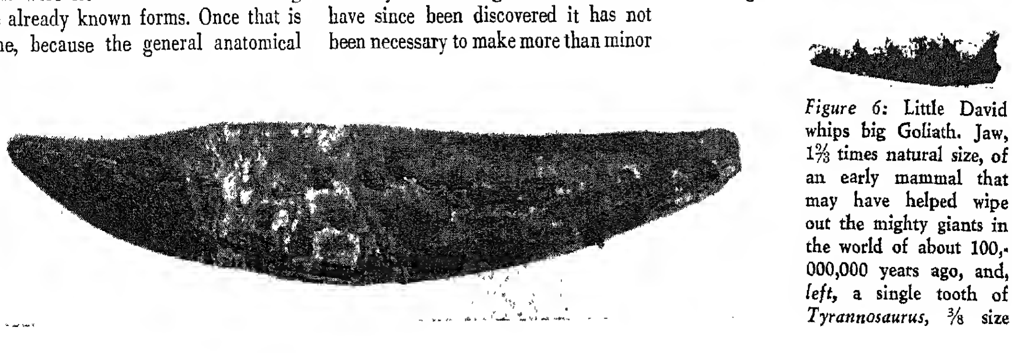
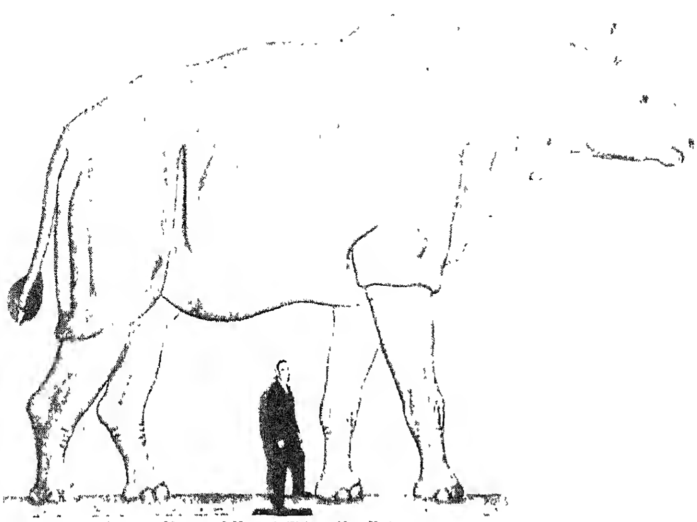


*Figure 6:* Little David whips big Goliath. Jaw, 1⅔ times natural size, of an early mammal that may have helped wipe out the mighty giants in the world of about 100,000,000 years ago, and, *left,* a single tooth of *Tyrannosaurus,* ⅜ size



Photograph by American Museum of Natural History, New York

*Figure 7: Baluchitherium,* not a dinosaur (reptile) but a mammal. Not even a contemporary of the dinosaurs, for it thrived only 35,000,000 years ago

exist that it is seldom that a specimen is discovered which does not show a definite relationship to known forms. If that rare event does take place we do our best to learn as much as possible from the remains in hand and then wait until more complete specimens turn up, as they are almost sure to do eventually.

In the case of the *Baluchitherium,* C. Forster Cooper of Cambridge, England, found the first remains in Baluchistan. India, in 1911. They consisted of only a few bones including one foot bone and two neck vertebrae. Yet from those few bones he concluded that they belonged to the largest mammal that ever existed and that the beast was probably an aberrant rhinoceros. Thus the matter rested for 11 years until we discovered the skull and part of the skeleton of a similar individual in Mongolia. Cooper was proved right on all the deductions he had made from these few bones.

THERE is another way in which we are helped properly to pose dinosaurs which lived a hundred million years ago. That is by the tracks which have been left in soft mud of some long vanished lake bottom, on the bed of a river, or the sands of an ancient sea shore.

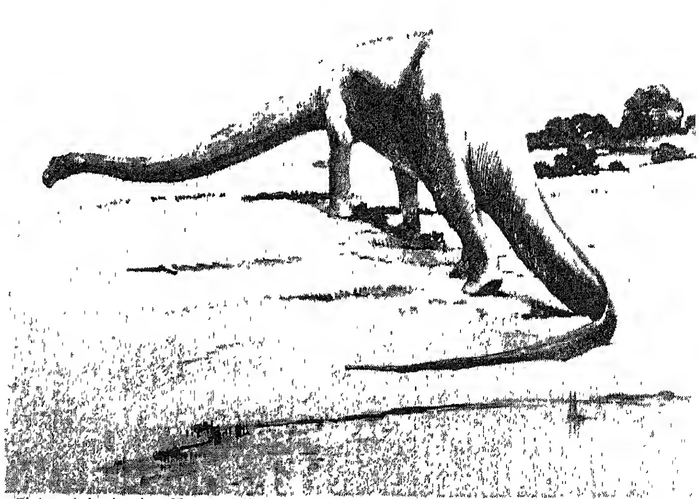
The finest dinosaur foot prints in America are from the Connecticut Valley. The estuary was subject to great fluctuations of water level, stretches of the flats being left dry and again covered by turbid water which deposited mud on the bottom. During the dry periods dinosaurs wandered along the muddy shores, leaving behind them hundreds of tracks of many different kinds and sizes. Strangely enough, they all lead from west to east as if the animals were following a well defined route to their feeding grounds. Some of the tracks show clearly where a dinosaur squatted down to rest or walked slowly on all fours, touching just the toes of the front feet to the ground like a kangaroo. From tracks in the snow the Indian can deduce a chapter. Likewise the scientist from these ancient mud tracks.

*Figure 9:* Small pebbles in *Protiguanodon mongoliense* skeleton

Footprints have been very valuable as aids in determining the correct attitude of several species of *dinosaurs* and in furnishing proof that some walked erect. In Belgium, where a great number of *Iguanodon* skeletons, a species related to the Duck-Bill, have been found, the natural moulds of the feet show that those dinosaurs walked like birds on the toes alone, and not flat-footed. Moreover, they must have carried their tails well up from the ground, counterbalancing the body, for otherwise there would have been a continuous furrow between the footprints. Where some of the short-limbed dinosaurs waddled along the tail furrow shows clearly.

Another glimpse of the personal habits of some species of dinosaurs is furnished by the stomach stones which have been found associated with skeletons. Chickens and other birds we know swallow pebbles to help digest their food. Some small vegetable-feeding dinosaurs did the same. In the Gobi Desert we found the complete skeleton of a small dinosaur beautifully preserved in red sandstone. It lay stretched out just as it had died. In the abdominal region right where the stomach lay was a neat little group of well worn, rounded pebbles which had undoubtedly been swallowed by the reptile. (Figure 9.)

When I watch the excavation of a dinosaur skeleton or a quarry, I always think that it is like translating a book from a little known language. For those who can read it the story of the rocks is often as plainly written as though it had been inscribed in stone. Every time a new creature is discovered it adds a few more words to the history of life upon the earth which we are endeavoring to translate for all to read.



Photograph by American Museum of Natural History

*Figure 8: Diplodocus,* resembling *Brontosaurus* but longer and swifter moving

# OUR POINT OF VIEW

## No Limitations

LOOKING back upon that momentous naval date, January 1, 1937, with the bewilderment of minds engrossed in weightier problems of the day and hour, all except the most rabid pacifists are rather ashamed of their dire naval prophecies of that date. It was to have been the beginning of the end of civilization, for the several naval limitations treaties expired on midnight, December 31, and hark ye! "tomorrow will begin a monstrous naval building race which will spell ruin to the world!" The experts were as guilty of this calamitous logic as were radio commentators and newspaper columnists and writers.

We say "looking back" as though New Year's Day were long past. It is! In terms of world events, it is almost forgotten in the mad rush of crisis after crisis. The few actual weeks that have passed have served to show that the tons of newsprint used in predicting a world naval upheaval were wasted so far as any effect upon the public is concerned. Naval boards go ahead with their ship plans, will lay down new ships, will build efficient, well-rounded fleets "for national defense," while the people (of every nation) go about their business of recovering from a depression, "sitting down" in factories, parading on Unter den Linden, riding on snow trains, uplifting Ethiopians, kidnapping their boss-generals, working hard, killing their brothers, and meddling in the private lives of everybody else. To this varied mob, navies don't seem to matter; the feeling seems prevalent that war vessels will be built anyway, so why let the question disturb!

There is a doubly tragic fact. No matter how much effort is expended to prevent it, war vessels *will* be built; and, except for a few sincere believers in limitations, individuals and countries briefly pay lip service to the limitations theory for expediency's sake and then complacently abandon it.

The United States, with all her faults (and may we enter here a modest denial of the holier-than-thou accusation!), more closely lived up to the letter and the spirit of the several naval treaties than did any other nation concerned. We sincerely believed in the practicability of limiting navies by agreement among the nations. We still do! Others, not quite so sincere; vacillating in their theory of government; peculiarly jealous of national honor; deluded by their own sense of importance; or (to be fair) forced by the actions of other nations—for these reasons, others caused the breakdown of all efforts to achieve naval limitations.

Seven nations are now powers on the seas—or are prospective powers. Besides ourselves, they are Great Britain, France, Japan, Italy, Germany, Russia. These seven are all building new ships outside the former limits of the treaties, or are planning to build. The cost to some *will* be ruinous, as the predictions stated. But perhaps it is a good thing; perhaps it will *save* civilization. Paradoxical? Only on the face. Some of us can outbuild the others two to one, or ten to one if need be; and we who can afford the race are the ones, fortunately, who most desire limitations. The others, their backs broken under the enormous burden of expense involved, may sue for stoppage of the race. Then may come that lasting international accord that will bring the world closer to the peace for which it has striven so hard and seemingly so futilely these past few years.

## Coals to Newcastle

PROGRAMS of "swing" music broadcast on short waves from a German station for the special benefit of American listeners provide the keynote of an anomalous situation that might be laughable if it did not have more serious aspects. The development of short-wave broadcasting—reflected monthly in the "World-Wide Radio" department published in this magazine—has opened avenues of communication that have far-reaching possibilities. Leaving aside the obvious opportunities for spreading insidious propaganda—a first thought in these troublous times in European politics—there are the more important phases of knowledge and culture that can be developed for the masses by means of short-wave programs. But these programs must be planned with an eye to these phases, and should not include such things as "swing" music for American audiences who are surfeited with this type of "entertainment" from their own stations.

When we consider that 6,700,000 radio receivers in the United States are capable of receiving short-wave programs from all parts of the world, it is easy to visualize the potential audience for foreign programs that are adequately planned to offer something worthwhile. Station directors in far-off lands will do much toward making their stations famous, and at the same time will do a notable service in bringing to the world a better understanding of their native lands, if they will so arrange those programs directed especially to foreign audiences that the music and other features will enable the listener for the nonce to transport himself, as it were, to the land where the program originates. Odd native musical instruments, folk songs, current events with a commentation in the language of the country to which the program is directed—these are some of the first-thought possibilities.

The few attempts that have been made in broadcasting cultural programs from foreign stations show what can be done, given the proper start. Our own powerful short-wave stations would do well to initiate a series of programs based on American life, culture, and progress, rather than to rebroadcast some of the commercial "plug" programs that clutter our broadcast band today. Such "plugs" hold little interest for foreign listeners, and only serve to give a distorted view of American life to these listeners who constitute the large majority of the audience.

## Inflation, or Deflation?

HAS the expanding universe hypothesis, even now but a few years of age, already reached the limit of its own expansion or inflation and begun again to contract or "pull in its horns"? There are signs on the horizon that what unfriendly critics of recent trends in science have called the maddest craze of all is scheduled soon to make way for a return to what they would regard as a saner point of view, a static universe hypothesis. This, of course, would vastly please all those (and there are many) who foolishly attempt to judge scientific matters merely according to their own intuitions of what "makes sense" and what doesn't. The same people often object to relativity on similar grounds, but such grounds come pretty close to being mere wishful thinking.

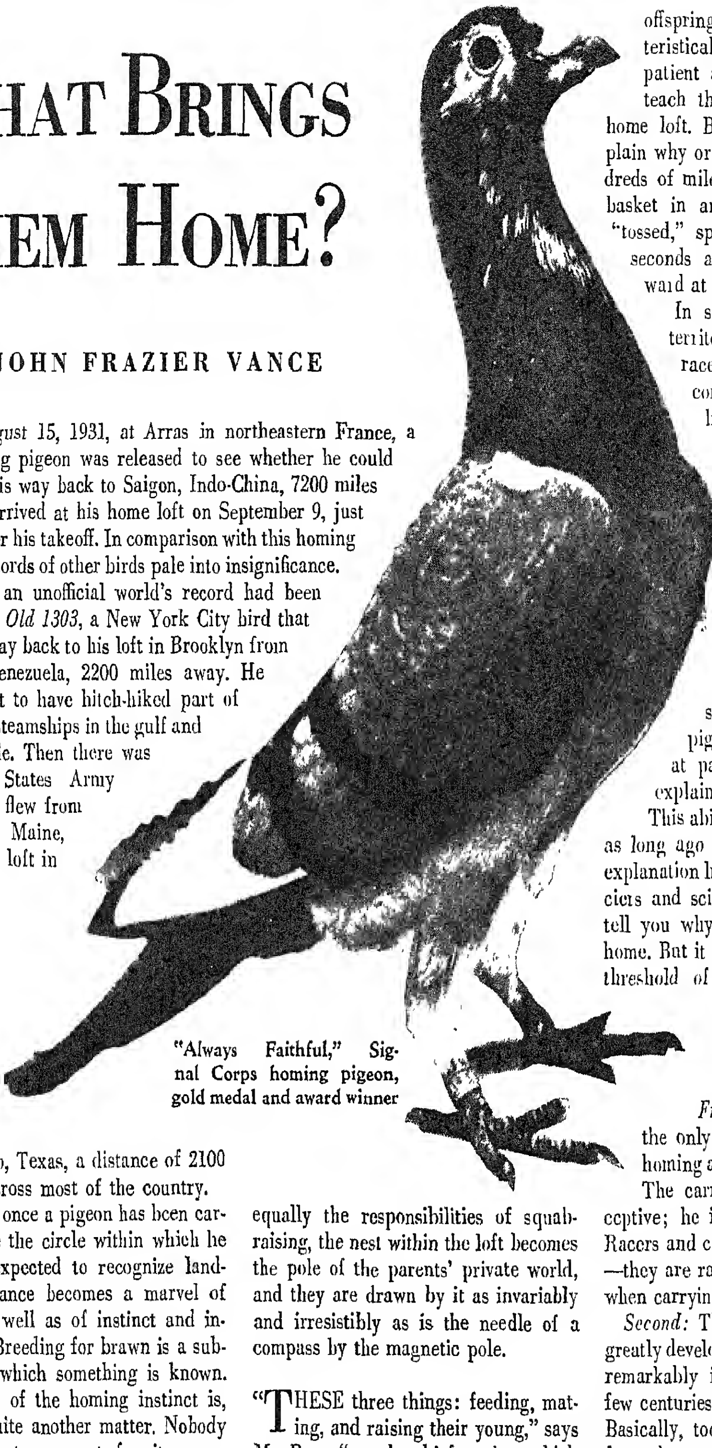
Science, however, must always be like a hound dog, faithfully following the scent wherever it leads; and in deciding which scents to follow, the evidence of actual experiment or observation (the scientific method) is the final guide.

Therefore, whether some of us happen to like an expanding universe, or whether we find a static one more pleasing, is of little real consequence. There is hope that the 200-inch telescope will finally settle the matter—and by the scientific method.

# WHAT BRINGS THEM HOME?

By JOHN FRAZIER VANCE

ON *August* 15, 1931, at Arras in northeastern France, a homing pigeon was released to see whether he could find his way back to Saigon, Indo-China, 7200 miles away. He arrived at his home loft on September 9, just 24 days after his takeoff. In comparison with this homing feat, the records of other birds pale into insignificance. Previously, an unofficial world's record had been claimed for *Old 1303*, a New York City bird that found his way back to his loft in Brooklyn from Caracas, Venezuela, 2200 miles away. He was thought to have hitch-hiked part of the way on steamships in the gulf and coastal trade. Then there was a United States Army pigeon that flew from Vanceboro, Maine, to his home loft in San Antonio, Texas, a distance of 2100 miles, or across most of the country.



"Always Faithful," Signal Corps homing pigeon, gold medal and award winner

However, once a pigeon has been carried outside the circle within which he might be expected to recognize landmarks, distance becomes a marvel of stamina as well as of instinct and intelligence. Breeding for brawn is a subject about which something is known. The marvel of the homing instinct is, however, quite another matter. Nobody knows how to account for it; some pigeoneers even deny that it exists.

Among these is Thomas Ross, the pigeon expert of the Fort Monmouth, New Jersey, Army Signal Corps Training School. In his opinion, a pigeon's ability to find its way to its home loft is merely a result of training. Teaching him from the time he is first ready to leave his nest that food will be found only in the loft establishes his first impelling association. When mating time comes, the loft acquires another lure for the pigeon that is a monogamist and pre-eminently domestic in tastes and habits. Finally, when the young are hatched, the strongest bond of all is forged, and as pigeon parents share equally the responsibilities of squab-raising, the nest within the loft becomes the pole of the parents' private world, and they are drawn by it as invariably and irresistibly as is the needle of a compass by the magnetic pole.

"THESE three things: feeding, mating, and raising their young," says Mr. Ross, "are the chief motives which bring pigeons home. So what is popularly called the 'homing instinct' is not really an instinct at all. It is largely an acquired trait and a matter of education."

However, those fanciers who insist that the homing instinct does exist point out that Mr. Ross has merely described three primary and powerful elements of the homing instinct and has not at all disproved its existence. For, they contend, every instinct is complex, and every instinctive animal reaction has its own end motivation. No one will dispute that a homing pigeon comes home because he has been taught that in his home loft he will find food, his mate and offspring. And pigeons are characteristically so stupid that it takes patient and persistent training to teach them to go directly to the home loft. But these facts do not explain why or how a pigeon, taken hundreds of miles from home in a wicker basket in an express car will, when "tossed," spiral upward for some 20 seconds and then streak off homeward at 50 miles per hour.

In short flights over familiar territory (and most pigeon races are flown under such conditions) it could be that he sets his course by landmarks, that he spirals until he sees a familiar tree or steeple or pond and thereby gets his bearings. But a sufficient number of successful flights are made every year over routes entirely new to the competing birds to demonstrate that the homing pigeon has a unique ability at pathfinding that cannot be explained so easily.

This ability was recognized at least as long ago as Solomon's day, but its explanation has consistently eluded fanciers and scientists. Today no one can tell you why a homing pigeon comes home. But it may be that we are on the threshold of finding out, for certain things are *known* about homing pigeons and what they can do. Of them, the most important are:

*First:* The homing pigeon is the only type which possesses the homing ability in any useful degree. The carrier pigeon's name is deceptive; he is now only a show bird. Racers and carriers now are all homers—they are racers when racing, carriers when carrying something.

*Second:* The homing trait has been greatly developed and the range of flight remarkably increased during the last few centuries by breeding and training. Basically, today's homer is descended from the sturdy, far-ranging wild rock pigeons of Europe. But he is a cosmopolite, indeed. Crusaders brought home with them to Europe veterans of the Pigeon Post of the infidel sultan Noureddin Mahoud; their descendents became famous as the English dragoon. The rock pigeon and the dragoon; the swift, low-flying ratta, a breed developed by the Mogul emperors of the East; and the India-born calumlet—all are ancestors of today's homer. (And, remarkably, so also is the owl, one of the pigeon's natural enemies.) These are the genealogical sources of his speed, his stamina, his sharp vision, his homing instinct and, as well, of his stupidity and stubbornness.

*Third:* He may be trained in this way (as he is by Thomas Ross at Fort Monmouth): As soon as the fledgling, or "squeaker," is ready to leave the nest he is fed corn and peas within the loft at regular intervals. When he is six weeks old, he is taken outside the loft and put back in again through a trap door. He is immediately given corn and peas. This is repeated until an association is firmly established: inside the trap-door, food! He is never fed outside the loft, and the corn and peas are always rattled loudly in a tin cup as he comes through the trap.

WHEN he has reached the age of 12 weeks, he is taken a little distance from the loft and released. Immediately he hears his corn and peas rattling in the tin cup in his trainer's hand inside the loft. He listens for a few seconds and then flies in. Day by day he is released at increasing distances from the loft and he acquires the habit of entering through the same trap each time.

When mating season comes, and later when the squeakers are born, the birds' training is intensified. They are taken from the loft one at a time and taught by repetition that the mate and the young will be found beyond the trap door that leads to the corn and peas banquet hall. Fanciers always try to enter in races birds that are courting or setting or raising young. This is comparatively easy in a loft of any size because pigeons mate at any season.

*Fourth:* Homing pigeons do not fly "bee-line" from the tossing point to the loft. They will fly around storms and fog, and will follow the easiest route.

*Fifth:* They do not, as a rule, fly in darkness. In that they are quite sensible. For one thing, a pigeon that has flown at a speed of about 50 miles per hour from dawn to dark has well earned a night's rest; for another, his most formidable enemies (after the thoughtless hunter who blazes away at anything that flies) come out at night.

*Sixth:* The average life of a homing pigeon is eight to ten years, although some live to twice that age. Their best racing and carrying feats are performed between their second and fifth years.

*Seventh:* They do not require a bird's-eye view to find their way home. Staff Sergeant Herbert E. Smith, of Fort Monmouth, tells of an instance at Fort Bliss near El Paso which demonstrates this fact. A bird released at some distance from the fort did not return on schedule. Days later he returned *walking*. In the interval he had been caught by someone who wanted to keep him, and who clipped his wings to guard against his straying away. But the bird came home anyway.

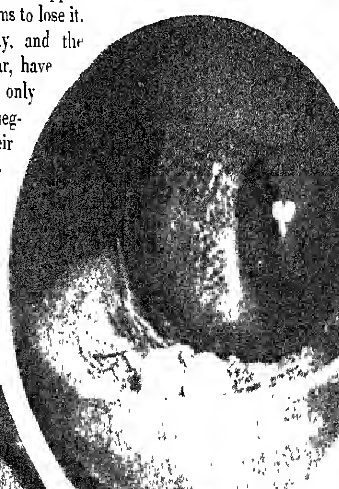
*Eighth:* Their ears are similar to human ears in that they contain a system of semi-circular canals. Some persons insist that through these canals flows the secret of the homing instinct. It must be, they say, that for the pigeon the aural canal does more than it does for man. It must be the center of his unique power, because if his ears are stopped or the canals injured he seems to lose it.

*Ninth:* Pigeons generally, and the homing pigeon in particular, have remarkable eyesight. Their only blind spot is the 10-degree segment directly behind their heads. Experiments also tend to prove that pigeons can see many times as far as human beings can.

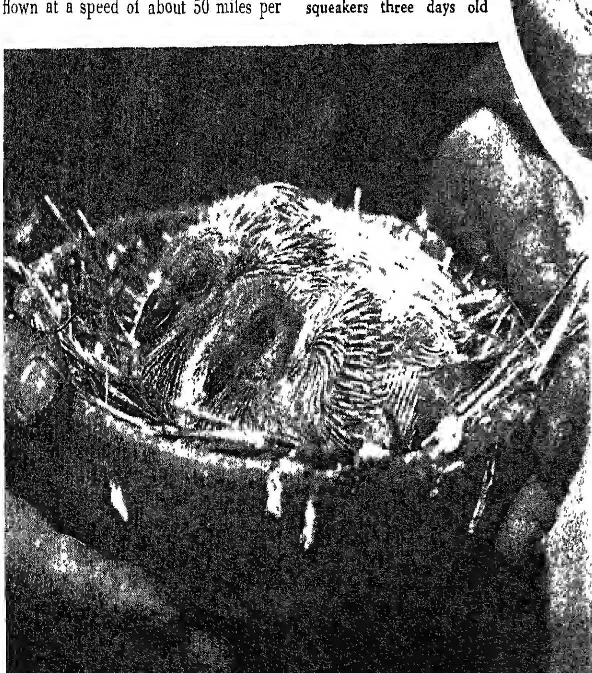
*Tenth:* Pigeons are baffled by radio broadcasting activity. Again and again instances have been reported in which well-trained birds have been confused, thrown off their course, or even forced to abandon flight merely because a broadcasting station lay in their path. Birds tossed from the roof of a broadcasting station while the station is idle, will go through their conventional 20-second spiral ascent and start for home. But let the broadcasting begin and the birds will circle helplessly for several minutes and finally settle to the ground again.

So much for the things we *know* about the homing pigeon which may relate to his homing instinct. Armed with them, we can venture into the realm of surmise and conjecture in which science, on a speculative lead furnished by Harlan T. Stetson, is searching for facts.

The remarkable bird which flew from Arras to Saigon will be a helpful example for us. He traveled in a wicker basket in the hold of a ship around India, through the Red Sea and the Mediterranean. He had no opportunity to select landmarks. He certainly could not see 7200 miles! Either thing was impossible.

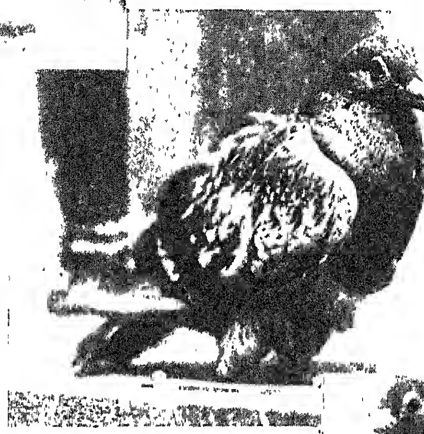


A setting hen homing pigeon at the right; and, below, a pair of pin-feathered squeakers three days old



But, suppose that the aural canals or some other part of the pigeon is in reality a living earth-inductor compass. That was the conjecture cautiously made by astronomer Stetson, who does not claim to know about pigeons but who can explain the earth-inductor compass clearly.

"On Lindbergh's flight to Paris," he says, "this renowned aviator made use of the so-called induction compass, which was merely a device utilizing a coil of wire carried by the airplane through the earth's magnetic field. Thus it generated a certain amount of current, which in



**Three heroes of the World War, of no particular pedigree. *Top:* "Spike"; and *center:* "Cher Ami"—both discussed in the text. *Bottom:* "President Wilson," a bird that, entrusted with an important message, arrived at his loft with a wounded leg and a bullet hole through his breast**

All photographs courtesy Signal Corps, U. S. Army

turn was recorded by a sensitive meter on the dashboard. If the plane got off its course, this coil would cut through the magnetic lines of force in a slightly different direction, resulting in a change in the amount of current generated. This would at once be indicated by the meter."

Now, returning to the bird which accomplished the 7200-mile flight: *If* nature has given him such an electro-magnetic device, all the way from Saigon to Arras he would be busily recording the direction of travel in preparation for his homeward flight. When the bird was finally tossed on that September afternoon, he would have only to find again the direction in which he had been carried from Saigon, and then fly in the opposite direction to get home.

It is a pretty hypothesis. It would explain so many things. It would explain why pigeons are confused by radio waves. It would explain why the El Paso bird found his way home on foot. It would fully explain the homing instinct. But it can only be proved by repeated experiments and observations, if at all.

AND whether it is proved or not, the pigeon will go on performing his wonders with increasing frequency and efficiency in a world which is constantly finding more work for him to do. Today, the homing pigeon, one of the oldest instruments of war, is being more and more widely used for the preservation of human life, the dissemination of knowledge, and the practice of a harmless outdoor sport in which competitors of all ages can participate on an equal footing. In recent months pigeons have won life-saving honors in the fishing fleets off Long Island. Large numbers of them have taken up the profession of journalism and often can get the news and even pictures through to headquarters more rapidly than any other means of communication.

And throughout the world there are literally hundreds of thousands of persons who revel in the hobby of pigeon racing. American racing pigeon enthusiasts are organized in clubs, at least one of which will be found in every city of any size throughout the country. They require four different magazines to record their activities. In the 5590 pigeon races flown under the supervision of the American Racing Pigeon Union in 1935, more than 1,200,000 birds competed.

It was doubtless the discovery by Americans during wartime that transportation of messages by homing pigeons was so fast and reliable (the Army Signal Corps reports that 90 percent efficiency was maintained by its flying messengers under fire) that has been responsible for the rapid development of pigeon lofts in the last few years. Even in New York City, where every type of communication known to modern science is more readily available than anywhere else in the world, the pigeon has found a niche. Since early 1935, the *New York Evening Journal* has been using pigeons in gathering its news. The *Journal's* ship news reporters take pigeons with them when they go to Quarantine, 14 miles down the bay, and release them with reporters' dispatches and films of arriving celebrities. These pigeons make the return trip to the roof of the Journal Building in about 12 minutes, whereas publishers of rival newspapers must wait two hours until the ship docks. News-running by pigeons is not an idea original with the *Journal's* City Editor, however. The ancient Greeks broadcast the winners of the original Olympic Games by pigeon post. And in 1850, New York's newspapers banded together to set up a pigeon news bureau at Sandy Hook. Within a half hour after a boat's arrival at Sandy Hook, this news was delivered to member newspapers in Manhattan by pigeons. This method was used for nearly 20 years.

In Milwaukee, Los Angeles, and San Francisco, pigeons are also used today for carrying the news in difficult circumstances. Spectacular recent service was rendered by homing pigeons in maintaining communication with the outside world when Pittsburgh's telephone service was deadened during the flood.

Until comparatively recently, the sport of pigeon racing and the art of training were largely confined to Belgium. It is to the Belgian immigrant during the last quarter of the 19th Century that America owes her present knowledge of the homing pigeon and the breeds which have been developed here.

In November 1917, the Adjutant of the American Army authorized the establishment of a Pigeon Section of our Army Signal Corps, and the birds were first used by our forces in the Aisne-Marne offensive, with mobile lofts near the front line. Seventy-two birds were employed, and in the period from August 29 to September 11 they carried 148 test messages and 78 messages of vital importance, maintaining a 100 percent efficiency. So remarkable was their performance in this first trial, that 567 birds were used during the St. Mihiel drive.

Members of the famous "Lost Battalion" of New York's 77th Division have particular reason to be grateful for the establishment of the Pigeon Section, because it was a message borne by *Cher Ami* that saved them from annihilation. This same bird carried 12 messages from Verdun to Rampont before he was dis-

abled by a shot which tore off one of his legs. On that flight he continued to the loft at Rampont with the message still dangling from the bleeding stump. He was idolized by the service, of course, and retired as an honored veteran.

Stories of remarkable performance by other pigeons under fire have frequently been told. There is the case of the famous *Spike*, an American Army bird bred and trained in France. Whereas most pigeons have pedigrees as formidable as any blooded stock, *Spike's* ancestry was largely unknown. Nevertheless he maintained a 100 percent average, delivering 52 messages under fire.

Then, there is the story of *The Mocker*. On September 12, 1918, with one eye destroyed by a shell splinter, he struggled home to his loft from the Beaumont front in the St. Mihiel sector.

IT is perhaps unkind to insist, in view of these remarkable performances, that the pigeon is lacking in courage. It must be admitted, however, that his continuance in flight after he has been injured is more probably due to an innate stubbornness which he exhibits under all conditions than to any nobler instinct. But whether courage or stubbornness brings him home is of slight importance, for the American Army does not propose to dispense with the services which the homing pigeon can render.

Although the homing-pigeon contingents were greatly reduced after the Armistice, training stations have been maintained, principally at Fort Monmouth, New Jersey, where, contrary to all previous experience, considerable success has been achieved in training them to fly at night. The lofts are darkened and the birds are taken out only after dusk. A light is kept in the loft and the birds, having eaten nothing since morning, fly back to their familiar loft for food. Night after night, as the distances are increased, they become more proficient in finding their way in darkness, and the Signal Corps confidently expects ultimately to develop a breed which can be relied upon to carry messages at night as well as in the day time.

In Germany, a war college is maintained for pigeon training which goes further than our American Army methods. These birds are trained to carry, on a special harness, a small panorama camera which makes exposures at predetermined intervals as the bird travels his course. This performance makes him still more valuable to an army in the field.

So the Dove of Peace is still being used and trained for the uses of war. It has even been suggested that the owners of the 900,000 privately owned birds in this country be carefully registered and inducted into a Signal Corps Reserve which can be called upon in time of emergency to multiply the Signal Corps Pigeon Section manyfold.

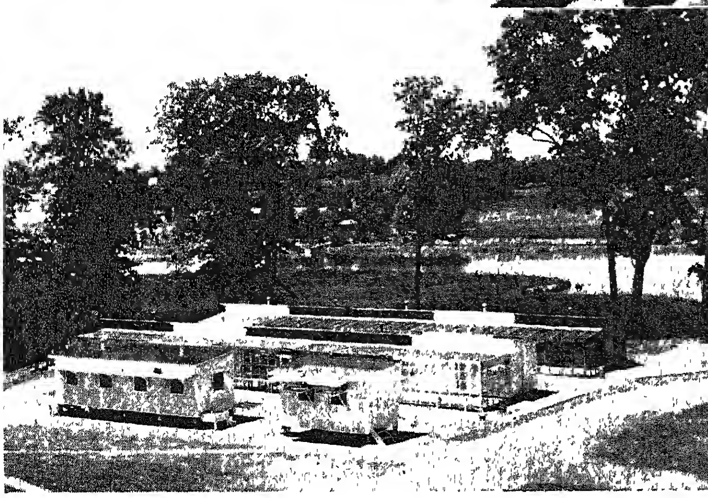
But the peace-time uses of the homing pigeon are growing with equal rapidity. For example, the fishing fleet which makes its headquarters in the harbor of Freeport on Long Island uses them to send back for assistance in case of trouble. The forest patrol uses the homer for reporting fires. And flyers who do not have adequate radio-sending apparatus frequently carry one or two birds in the cockpit to enable them to communicate with their home field in case of accident.

When birds are returned to their lofts at unexpected times for assistance, it is simple enough to rig a signaling device to announce their arrival. Such an electrical alarm, set in operation automatically, is used by the Freeport fishing fleet.

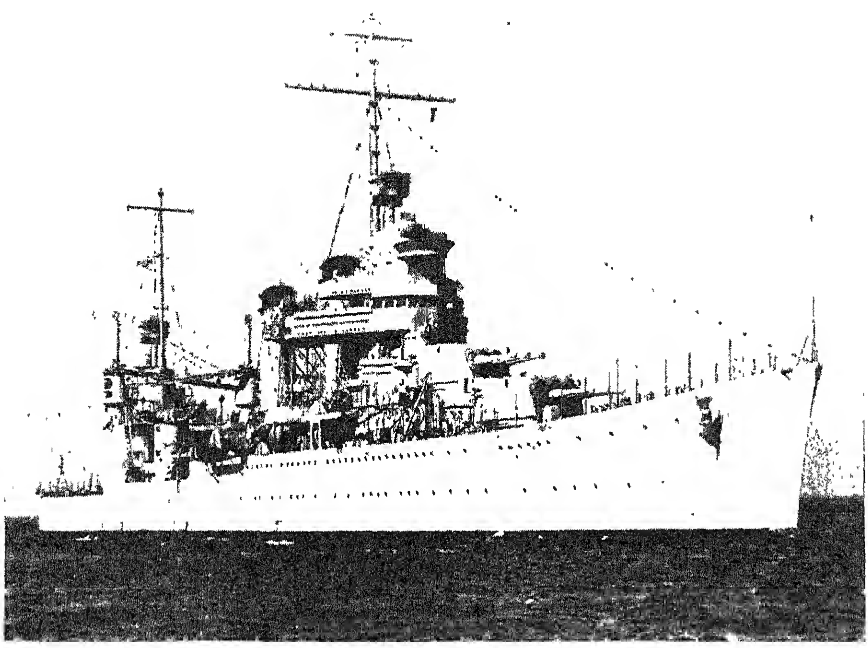
Greater and greater peace-time uses will be found for the pigeon if the sport of falconry is not too actively revived and if the type of hunter who likes to take a pot-shot at anything that flies can be persuaded to exempt this useful bird. There is scarcely a single important pigeon race from which one or more do not return with shot-gun pellets lodged in breast or wings, and many a fancier hesitates to "toss" a valuable bird when these hazards exist.

Pigeons with pedigrees bring 25 to 50 dollars a head as a usual thing, although they have sold for as high as 6000 dollars. The cash investment in birds, plus the labor of training, which is considerable, makes the pigeon fancier's wrath at the pot-shot hunter understandable. His defense against them and against the duck hawk is merely the pigeon's natural fecundity. A fancier's hope is that

Two birds, *above*, being placed in the basket in which they will be carried out to sea before release. *At left:* Message capsule on a pigeon's leg. *Below:* Some of the pigeon lofts at the training station, Fort Monmouth, N. J.



the homing breed will not follow the passenger pigeon into oblivion. This handsome breed 50 years ago nested in countless multitudes in the wonderlands of our middle western states, particularly in Indiana, Ohio, and Kentucky. However, hunters succeeded, in the course of years, in exterminating the passenger pigeon entirely, the last specimen having died in the Cincinnati Zoo in 1914. With this example freshly in mind, the publications devoted to pigeon culture make a consistent effort to educate the public to protection of the pigeon because of its tremendous value as a messenger in time of peace as well as in time of war.



Commissioned last year, the U.S.S. *Quincy* is our sixth of the *Minneapolis* class, the ships of which are exceedingly well protected in contrast to the earlier *Augusta* and *Pensacola* classes

# AMERICA'S HEAVY CRUISERS

## Step by Step, Design, Armament, Armor Have Been Improved with Each New Cruiser Class . . . We Now Have An Efficient Cruiser Fleet

**By WALTON L. ROBINSON**

WITH the commissioning for service last June of the U.S.S. *Quincy*, the number of available heavy cruisers of the United States Navy was increased to 16. The new ship is similar in design to the five completed in 1934—the *Minneapolis*, *Astoria*, *New Orleans*, *San Francisco*, and *Tuscaloosa*. Including the light cruisers of the *Omaha* class, our navy now possesses 26 modern cruisers totaling 223,000 tons.

The *Quincy* and her five sister ships (officially known as the *Minneapolis* class) are the last word in modern cruiser design according to American ideas, and they compare most favorably with contemporary foreign cruisers. It will be recalled that the Washington Naval Conference of 1922 fixed the maximum standard displacement of future cruisers at 10,000 tons and the size of their guns at eight inches. During the past seven years this country has completed 16 ships of this type. Each succeeding group has embodied improvements over the preceding one.

Our first two 10,000-ton cruisers—the *Pensacola* and the *Salt Lake City*—were not very successful men-of-war, although certain alterations made since their completion have improved them greatly. Their strongest point is their main armament of 10 8-inch guns, but this imposing offensive power was obtained at the expense of adequate protection. Those two ships are of rather awkward appearance with their lofty tripod foremasts, flush decks sheered up sharply from amidships to the bow, and high fore and after shelter decks, upon each of which is mounted a triple 8-inch-gun turret or gun-house. Four airplanes are carried, and for the launching of these, two catapults are provided. The armament is composed of 10 8-inch guns, four 5-inch anti-aircraft guns, and six 21-inch torpedo tubes. The engines develop 107,000 horsepower for a speed of 32.7 knots.

IN the construction of these ships, as in all subsequent heavy cruisers, the greatest possible economy of weights was practiced. Aluminum alloy fittings replaced steel, and aluminum paint is used internally. Welding was employed wherever possible instead of rivetting. These two cruisers suffer from their low freeboard, and, as first completed, vibrated badly. This has been corrected, but they still roll a good deal at low speeds, although above 20 knots they are very steady, even in bad weather.

In the *Augusta*, *Chicago*, *Houston*, *Northampton*, *Chester*, and *Louisville*, which followed a year or so later, the design was altered radically. The main armament was reduced by one gun, nine 8-inch guns being mounted in three three-gun turrets. This reduction in offensive power made possible the addition of some much-needed armor over the vital spots of the ships. A notable improvement was made with the provision of a hangar for the four planes carried. The hull lines and superstructure were modified considerably and these six cruisers have a distinctive silhouette. The sheered flush deck of the *Pensacolas* gives way to a broken deck with a rather short forecastle, and there are but three gun-houses instead of four. The anti-aircraft and torpedo armament in these ships is the same as in the preceding class.

All-in-all, the *Augusta* and her sister ships may be regarded as quite an improvement over the *Pensacola* class; however, they have not proved particu-

early successful. Because the center of gravity was placed too low, they roll considerably, just as do the earlier ships. The *Chicago*, *Houston*, and *Augusta* are fitted as flagships, extra accommodation being secured by extending the forecastle aft to the catapults.

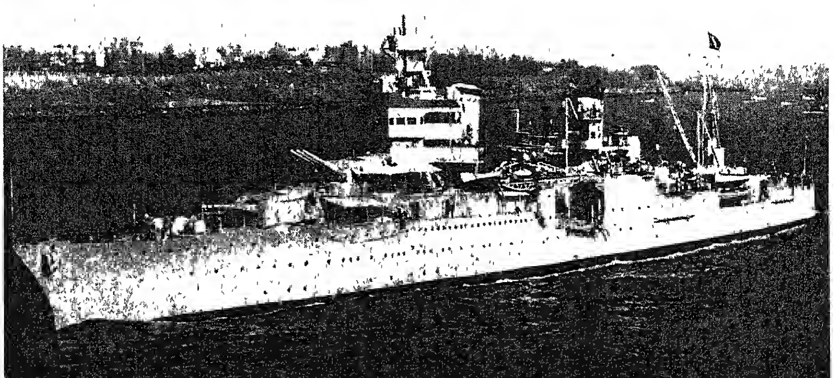
The next two ships, the *Portland* and *Indianapolis*, are simply improved copies of the *Augusta* class. The anti-aircraft armament was doubled, eight 5-inch guns being mounted instead of only four. Torpedo tubes were provided in the original designs, but the ships, as completed, do not carry any. Various modifications also were made in hull design, and the superstructure was considerably reduced. As a result, both ships behave very well at sea. Additional protection was also worked into the design. These ships can readily be distinguished from those of the *Augusta* class by their short tripod foremasts and their light tripod mainmasts. The *Indianapolis* is fitted as a flagship, with extended forecastle.

The *Portland* class was followed by the six cruisers mentioned in the opening paragraph. The design of these marks a distinct breakaway from that of the three earlier classes. Only in such general characteristics as displacement, armament, and speed is there any similarity. In silhouette, the new ships are quite unlike anything which previously has appeared in our Navy. Aside from these alterations in appearance, which will be described fully in a later paragraph, the most important change, and one invisible to the eye, is the amount of armor protection carried by the new vessels. In this respect they form a striking contrast to the *Pensacola* and *Salt Lake City*. Whereas these two latter ships are but very indifferently armored, the new cruisers have been given some fairly good protection. It is reported that armor of five inches or more in thickness is carried over vital parts, while even the bridges have been given a patch of thin plating. These ships are much better protected than Great Britain's fine, ruggedly-built 10,000-ton cruisers of the *Kent*, *London*, and *Dorsetshire* classes, and are also somewhat superior in this respect to France's latest heavy cruiser, the ungainly-looking but sturdily armored *Algérie*.

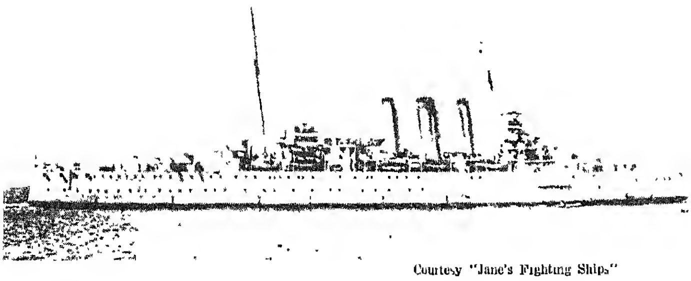
THE *Quincy* and her five sisters carry the same armament as the preceding ships of the *Portland* class, i.e., nine 8-inch guns and eight 5-inch anti-aircraft guns. The torpedo armament has been suppressed entirely; it was not even included in the original plans. These are among the very few modern cruisers which do not carry torpedo tubes. In their 10,000-ton cruisers, England, France, Italy, and Spain have mounted, respectively, eight, six, eight, and twelve torpedo tubes. Japan has placed eight tubes on four of her heavy cruisers, and twelve on the remainder. Germany's all-too-famous 10,000-ton "pocket battleships" of the *Deutschland* class are each provided with eight tubes, while her pair of eight-inch gun cruisers, now building, are expected to carry twelve. Aside from our new cruisers of the *Minneapolis* class, and the two *Portlands*, only six modern cruisers are at present without a torpedo armament —the 6670-ton *Java* and *Sumatra* of the Royal Netherlands Navy, and Italy's four 10,000-ton cruisers of the *Zara* class. In view of the almost universal practice of providing cruisers with a torpedo armament, the decision of American naval authorities to forego this weapon on our latest cruisers may well be regarded as a rather bold step. It is understood that the Navy Department intends to remove the tubes now mounted on all our earlier 10,000-ton cruisers. The weight and space thus saved will be employed to augment the anti-aircraft batteries of these ships. Torpedo tubes will be retained, however, by the ten 7050-ton *Omaha* class, light cruisers now in service.

As mentioned briefly in a previous paragraph, the general appearance of the new cruisers differs radically from that of the earlier ones. Instead of the pronounced over-hanging yacht or clipper bows of the older ships, the newest ones have almost straight stems—only a slightly curved overhang. The forecastle deck is much longer in the new ships and is sheered up noticeably from the foremost gun-house. The tripod foremast with its heavy director tower and searchlight platforms has been abolished, and its place taken by a light pole rig. The directors have been shifted to a position atop the towering bridgework, and the searchlights to a lofty platform between the pair of raking funnels. These are both extremely tall, though of unequal height (the fore-funnel is several feet taller than the second one) and rather close together. Behind the funnels are two airplane catapults. On the older ships these were placed between the funnels, which were located quite some distance apart. Abaft the catapult, and forming part of an imposing after-superstructure, is the plane hangar. Atop this are two cranes for handling the planes and small boats, as well as a light, short, raking pole mainmast, director tower, and other equipment.

Under the terms of the London Naval Treaty of 1930 (which expired December 31, 1936), this country will have in service in the course of the next few years 18 10,000-ton cruisers armed with 8-inch guns. Of this number, all but two are now completed and in active service. They have all been described in the foregoing paragraphs. Of the remaining pair, the *Vincinnes* is at present under construction at the Fore River yard of the Bethlehem Shipbuilding Corporation and the *Wichita* is under construction at the Philadelphia



**The U.S.S. *Indianapolis* forms, with the *Portland*, the third group of heavy cruisers built by this country. She is the flagship of the Scouting Force, and has served on several occasions as the Presidential flagship**



Courtesy "Jane's Fighting Ships"

H.M.S.*Cornwall*, typical of Britain's thirteen 10,000-ton cruisers. Note high free-board; flush deck; four gun-houses, mounting two 8-inch guns each; and single catapult to be seen amidship

H.I.J.M.S.*Nachi*. Japan's other seven heavy cruisers are of similar appearance. Due to low free-board, heavy armament, and excessive top hamper, these behave badly at sea. Note five two-gun turrets

Navy Yard. The first is due for completion in 1937 and the second in 1938. In all probability, the design of these ships will closely follow that of the *Minneapolis* class.

The London Naval Treaty of 1936, signed by this country, Great Britain, and France, provides for a holiday in the construction of additional 10,000-ton cruisers armed with 8-inch guns; hence the *Wichita*, when completed in 1938, will probably be our last cruiser of this type for some years to come.

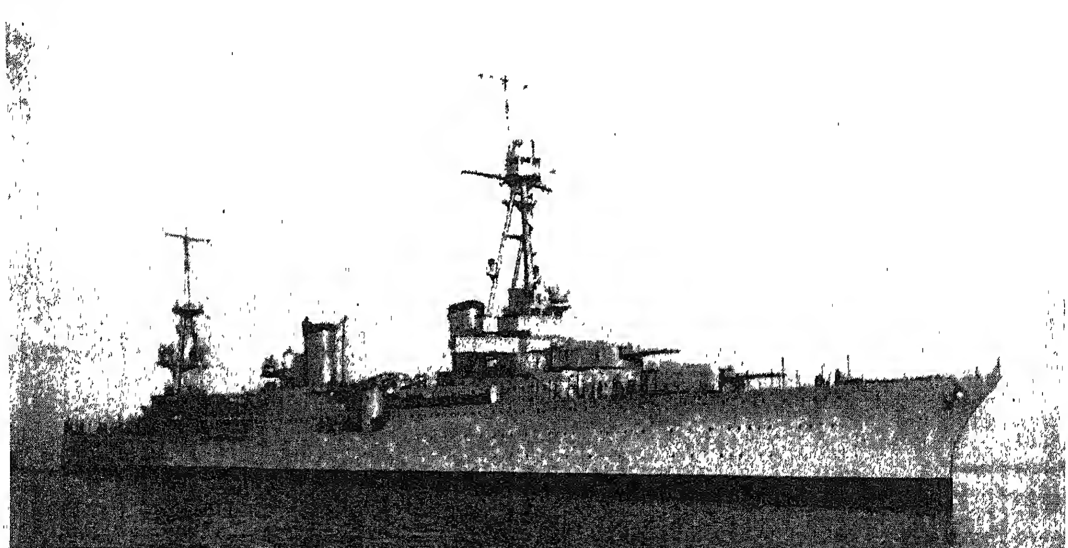
The United States Navy also has at present under construction seven other cruisers of 10,000 tons displacement, but as they are to carry 6-inch guns instead of 8-inch, they are light cruisers and not heavy ones. Thus they do not properly enter this discussion and it will be necessary to dismiss them with a few brief remarks. Suffice it to say that they are expected to carry no less than 15 6-inch guns mounted in five triple gun-houses. All are due for completion in 1937. Funds for the construction of two additional light cruisers have been appropriated. Unlike their British and Japanese counterparts, these nine cruisers will not carry torpedo tubes.

With the completion in 1934 of the five ships of the *Minneapolis* class, and in 1936 of the *Quincy*, the United States Navy possesses the most homogeneous heavy cruiser force in the world. All 16 vessels have been designed for a uniform speed, and all save the earliest two carry nine heavy guns arranged three to a gun-house, two of which are in a position to train directly forward, one aft, and all three on the beam.

THE foreign navies, on the other hand, have not been as consistent in the design of their eight-inch gun cruisers. Of Great Britain's 15, 13 are of 10,000 tons and mount eight guns. Of these ships, seven are capable of a speed of 31.5 knots, and the remaining six of 32.25 knots. England's list of post-war heavy cruisers is completed by two 8400-ton ships carrying but six 8-inch guns and able to steam at 32.25 knots. Of France's seven 10,000-ton cruisers, two are good for more than 35 knots, four can make but 33, and one only 32 knots. Three of Italy's heavy cruisers can steam from 35 to 36 knots, and the remaining four only 32 knots. Each of these French and Italian ships carry eight 8-inch guns. All of Japan's 12 heavy cruisers are designed for a speed of 33 knots, but four of them are of only 7100 tons displacement and mount only six 8-inch guns. The remaining eight ships displace 10,000 tons and carry 10 8-inch guns in two-gun turrets.

The markedly superior homogeneity of our heavy cruisers in armament and speed, and especially in the latter, is of the utmost value, and it is to be earnestly hoped that this policy of giving all our cruisers a uniform speed will be continued in the future. At present, not only are all of our 10,000-ton cruisers designed for 32 to 32.7 knots, but also our 10 7050-ton, 6-inch gun, light cruisers of the *Omaha* class, while the 10,000-ton light cruisers, now building, are expected to do 32.5 knots.

Summing up, therefore, we find that in active service the United States Navy has a force of 26 modern, well-armed, fairly fast cruisers, while 11 additional ones are under construction or soon will be. The development of this splendid force of heavy and light cruisers has been an important step toward the attainment of the government's goal—a navy second to none.



The U.S.S.*Augusta*. Compare with *Quincy* and *Indianapolis*

# 52-YEAR-OLD FIRE FOUGHT BY WPA

By C. A. ROBINSON

Flames burst through a tunnel of a recently worked small wagon mine

A crater in the hillside that spouts steam and water at regular intervals

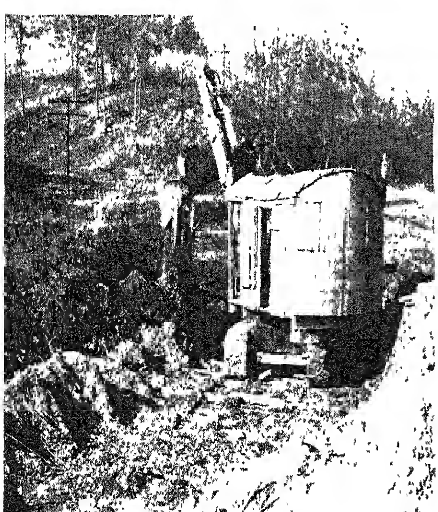
FAMILIES that have lived for generations on the slopes of Mount Vesuvius have become accustomed to the presence of molten rocks, steam and gases. So it is with the residents of the Hocking Valley of Ohio who have lived for 52 years over a burning coal mine. This fire, which was started during labor trouble in 1884, has spread underground to great distances and often burns through the surface at unexpected places. So far, something like 50,000,000 dollars' worth of high-grade coal has been destroyed, and additional fields worth a billion dollars are menaced. In the past, much time and money have been unsuccessfully expended in trying to stop this destruction.

A determined effort will now be made to choke the fire by limiting the fuel on which it feeds. Three projects are now in hand to cost 365,000 dollars, and WPA workers are making rapid strides in their fight to extinguish the fire.

Two types of barriers have been proposed to confine the fire to an area of about seven square miles. Where the coal is close to the surface, steam shovels will remove the coal as in "strip" mining. A ditch barrier will then be dug wide enough to stop the progress of the fire, this ditch being filled with dirt after the coal is removed. The other type of barrier is a tunnel which will be driven through the coal seam to divide it. To prevent the fire from jumping across the tunnel, holes will then be driven down to it from the surface and through these holes will be pumped a stream of mud until the tunnel fills.

WPA workers preparing the way for a steam shovel in an old mine

A cave-in caused by burning away of supporting coal layer underground



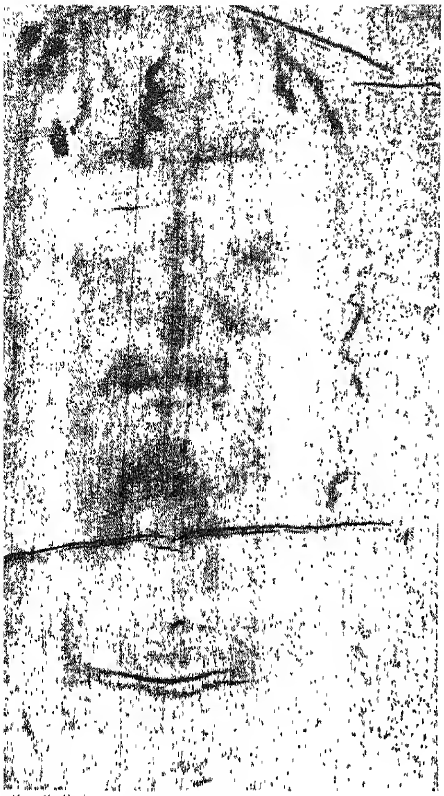
A steam-shovel stripping off the overburden preparatory to the digging of a deep trench, later to be filled with dirt

Something that happens in unexpected places! This farmer found smoking fissures in his cornfield one morning

# THE PROBLEM OF

By PAUL VIGNON, Sc.D.
Professor of Biology at the Institute Catholique, Paris
Secretary General of the Italian and the French Commissions of the Holy Shroud

Translated from the French by
**EDWARD A. WUENSCHEL, C.SS.R., S.T.D.**



Cav. G. Enrie

l of the face, showing negative imprint and weave
e cloth. The transverse lines are shaded wrinkles

IN 1902 the Scientific American[1] reprinted a report which I submitted to the Academy of Sciences at Paris relative to the remarkable cloth known as the Holy Shroud. This cloth, preserved in Turin, Italy, is venerated as the winding-sheet of Christ. Upon it are two figures, which represent the front and the back of a human body and are believed to be the imprints of the Body of Christ. In 1898, when the Shroud was photographed for the first time, it was discovered that the lights and shades of these figures are reversed as in a photographic negative. This led me to make a series of studies and experiments, in which I was assisted by several colleagues at the Sorbonne. Our findings in the laboratory tended to confirm the traditional belief about the figures on the Shroud. On the basis of several historical documents, however, many scholars, Catholic as well as non-Catholic, maintained that the figures (page 148.—*Ed.*) are paintings, dating from about the middle of the 14th Century.

Since then much light has been shed upon the question, both for the scientist and for the historian. In 1931, when a public exposition of the Shroud was held, Cavaliere Giuseppe Enrie made some excellent photographs of the entire Shroud and of all the details of the figures, the work being done in my presence and partly according to my suggestions. During the exposition, which lasted three weeks, we saw the Shroud repeatedly in different conditions of light, for long periods at a time, and on several occasions were allowed to handle it. Afterwards two Commissions were formed, one in Turin and the other in Paris, to study the question from every angle. In 1933, during another exposition of three weeks, the Shroud was again examined by many critical eyes, and the Commissions continued their investigation with additional data to guide them. Though they have not yet completed their work, they have made considerable progress.

It is quite certain that the figures on the Shroud are not paintings of the 14th Century. There are many representations of Christ, notably the image of Edessa, which could have been derived only from the Shroud. A careful study of these copies, which I completed recently, shows that the present Shroud of Turin was in Constantinople during the 12th Century, and that the face visible upon it served as a model for artists as early as the 5th. The artists did not copy slavishly, but tried to interpret the face, translating the mask-like features into a living portrait, which was still a recognizable copy of the original. This disposes of the only positive objection ever brought forward in the name of history.

The figures on the Shroud, in fact, are not paintings at all. As already stated, they are negative images, and the idea of a negative became known only through the invention of photography in the 19th Century. No artist of any earlier period, therefore (certainly none of the 14th Century and, above all, none before the 5th), could have conceived the idea of painting a negative.

The figures, moreover, are very exact negatives. When they are photographed, they appear on the film with the natural proportions of a full-grown man, with a true perspective, with a noble, impressive countenance, and with a minute fidelity to nature even in minor details. Each one of these points involves principles of science and of art which were unknown or poorly grasped until comparatively modern times. It is hard enough to carry out these principles in an ordinary positive painting, in which the lights and shades have their normal values. On the Shroud, they are perfectly illustrated with the lights and shades reversed, though it takes a photograph to reveal the fact. Even today no artist can paint so exact a negative. No artist, in fact, has yet succeeded in making an exact copy of the negative figures on the Shroud, though competent artists have made the attempt.

SINCE the figures are not paintings, since they could not have been produced by any other artificial means, it remained to investigate whether they could have been produced by some natural process. After analyzing the first photographs of the Shroud and making our experiments in the laboratory of the Sorbonne, we concluded that the figures are the direct imprints of a human body. It was obvious at once that they were not produced by mere contact, for contact between the pliable cloth and the irregular surface of a human body would have caused considerable distortion, and there is little or no distortion in these figures. They could have been produced only by the action of vapors given off from the surface of a body, the action being most energetic where the reliefs of the body touched the cloth or were very close to it, less and less energetic at the concavities and the sides as the *distance* between the body and the cloth increased. That is why the resulting stains have such a delicate diffusion, shading off gradually till they fade away entirely. That, too, is the reason why the figures are negatives, the reliefs having caused a darker stain than the cavities and the depressions.

With the aid of Lieutenant-Colonel Colson, then Professor of Physics at the École Polytechnique, I was able to determine what kind of vapors had acted on the cloth: humid ammoniac vapors, resulting from the fermentation of urea, which is exceptionally abundant in the sweat produced by physical torture and by fever. We also determined that the

[1] Vol. 86, pages 367-8, May 24, 1902.

# THE HOLY SHROUD

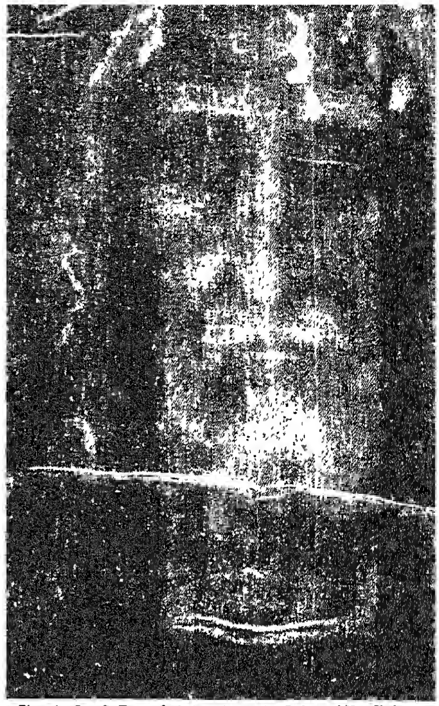


Photo by Cav G Enrie ©1933, Redemptorist Fathers of New York
How the face appears when the lights and shades a
versed by photography. Above the head is a water

vapors had reacted with aloes. which were spread on the cloth and sensitized it to the action of the vapors. The detail photographs show that the aloes were in powder form. In my experiments I found that it was sufficient--favorable. in fact—that only a small amount of the aloes should remain on the cloth I obtained imprints like those on the Shroud by placing cloths prepared with aloes over plaster figures soaked in a solution of ammonia. I proceeded in this way because it is impossible to have a human body in the requisite condition—one recently done to death by torture, as was the body which caused the imprints on the Shroud.

The conclusions which we reached after our first investigation have been confirmed by the new evidence derived from the two examinations of the Shroud itself, from the more exact photographs taken in 1931, and from subsequent experiments by members of the Commissions. It is now established also that there are particles of blood on the Shroud, so well preserved that they still show the composition of the blood. Beyond doubt, the two figures on the Shroud are the imprints of a human body.

This body was evidently that of a man who was crucified. The wound in the hand which can be seen (page 148) is placed (contrary to the universal practice of art) where the anatomy of the hand requires. Before crucifixion the man was scourged. From the markings I have reconstructed the scourge that was used. It was the kind called *flagellum*, having two or three thongs, each of which was provided with a metal ball at the end and with another about an inch and a quarter from the end. The man was also wounded about the head, as is shown by the trickles of blood and by several distinct punctures on the brow. There is a wound in the right side, such as would be caused by the stroke of a lance. Pierre Barbet, M.D., of the French Commission, has shown that the weapon entered between the fifth and the sixth rib and pierced the right auricle of the heart. The doctors of both Commissions are agreed that serum flowed from this wound with the blood, and that this is a sure sign that the man was dead when the wound was inflicted.

Briefly, the imprints on the Shroud are those of a man who was tortured exactly as is recorded of Christ in the Gospels. But was this man really Christ? In the present state of the question, this is the only problem to be solved.

At the very outset it would seem that these cannot be the imprints of Christ. On the brow and at the back of the head there are the traces of many small drops of serum, indicating the first stage of decomposition. Of Christ, however, it is written that He was not to see the corruption of the grave. This is true; but just as the death of Christ resulted from natural causes, so was His dead Body subject to the operation of natural causes as long as He remained in the tomb. These signs of an incipient decomposition, therefore, are no difficulty.

Neither is there any difficulty in a cloth being preserved intact for 19 centuries. The Shroud, which is made of linen, is actually in a good state of preservation, except where it was damaged by fire[2]; but there are Egyptian linens 3000 years old which are still as good as new. There is just as little difficulty in the fact that the Shroud is woven in a twill pattern. for the ancients wove twilled fabrics of excellent workmanship, and the art of weaving was highly developed at the beginning of the Christian era.

BUT there are gaps in the history of the Shroud. We have no complete record by which we can trace this cloth back to Christ. At most, this is a negative objection. For one thing, there were various reasons, of prudence and of religion, for the silence of the very first centuries. It is very likely, too, that early documents referring to the Shroud were lost or destroyed. The copies of the Shroud, however, to which I referred above, supply to a great extent for the lack of written records, since they prove that our present Shroud, with the imprints, existed at the beginning of the 5th Century. A text from the "Illatio," the Preface of the ancient Spanish Liturgy for the Saturday after Easter, shows that it was known in Spain in the second half of the 7th Century that the Shroud of Christ bore the imprints of His Body. A cloth which was venerated as the Shroud of Christ was preserved for many years in the Imperial Palace at Constantinople. Here it was not put on exhibition: but about 1203, when it was kept in the famous chapel of Our Lady of Blachernes, it was stretched out at full length every Friday, so that all could clearly see "the figure of the Lord." In 1204, when Constantinople was pillaged by the Crusaders, the Shroud disappeared. About 1355 we again find it, at Lirey, near Troyes in France. This was undoubtedly our present Shroud, for from this point onward it has a clear and continuous history. There are no documents to prove that it is the same as the Shroud of Constantinople, but certain copies of the Shroud, made at Constantinople, prove it, and prove it despite the silence of Lord Geoffrey I de Charny, who brought the Shroud to Lirey, as to how it had come into his possession. It is to the point, moreover, to note that Lord de Charny went to the Orient as a Crusader in 1346.

In 1453 the Shroud was entrusted to the care of Duke Louis I of Savoy, residing at Chambéry. Ever since then the House of Savoy, now the Royal House of Italy, has guarded it with the greatest honor. In 1578 the then reigning Duke of Savoy had it transferred to Turin, where it is now enshrined in a magnificent chapel adjoining the cathedral.

History, then, does not prove that the Shroud of Turin is the identical cloth in which the Body of Christ was wrapped, though it does show that it has every chance of being that cloth. We do

[2]This fire occurred at Chambéry, France, in 1532. The Shroud was folded several times in a silver case and was scorched along the edge of the folds, whence the two dark lines enclosing the imprints. One corner of the folds was burned through by a portion of molten silver where the triangular patches now are. The Shroud also received several water stains through the middle and along the sides.

not depend upon extrinsic sources, however, to decide the question. The Shroud itself, by reason of those remarkable imprints, is a document of the highest value, which the eye of science can read as clearly as if it were a manuscript written and signed by him who caused the imprints.

Before reaching a final conclusion we considered this question: Can the imprints be those of some other person besides Christ? In the end we had to grant that this is impossible. All the conditions necessary to produce the imprints were fulfilled in Christ, and could not have been fulfilled in anyone else.

THE imprints show that the man was scourged, crowned with thorns, crucified, and pierced through the side. From the Gospels we know that all this was done to Christ as the result of exceptional circumstances. It is hardly likely, therefore, that the same series of outrages was inflicted on someone else. The man, moreover, was already dead when his side was pierced, as is shown by the blood and serum which flowed from the wound. The Gospels state that Christ was dead for about an hour when the soldier drove the lance into his side —"and immediately there came forth blood and water." It is still less likely that this occurred in some other case, the more so since it was something unusual in connection with crucifixion.

The manner in which the body was enclosed in the Shroud was also exceptional. It was customary for the ancients to wash and anoint a corpse and to swathe it in linen bands, besides wrapping it in a shroud. In this case the corpse was simply enveloped in the long sheet[3], upon which there was a certain amount of powdered aloes; and though the corpse was covered with sweat and blood, it was not washed or otherwise prepared for burial. This is exactly what happened with the Body of Christ. It was laid in the tomb enveloped only in the "clean linen cloth," just as it was when taken down from the cross. With the cloth there was a mixture of spices containing aloes, which were in powder form when used for such a purpose in the ancient Orient. The Body of Christ was treated in this summary fashion because the Sabbath was about to begin, making it necessary to postpone the ritual burial. It is hard to imagine the same combination of circumstances and apparent accidents in any other case.

Finally, the body could not have been enclosed in the Shroud long enough for decomposition to advance beyond the first stage, otherwise the imprints would have been destroyed. The Gospels relate that this condition was fulfilled by Christ, but only because He rose again, about 30 or 35 hours after His Body was laid in the tomb. In any other case someone would have had to remove the Shroud at exactly the right time and after all the other conditions were fulfilled, which seems quite impossible.

If, then, we take all the conditions which were necessary to produce the imprints, it must be granted, I think, that the data of the Shroud, with the Gospels as a key, are a means of identification as sure as a photograph or a set of fingerprints. It was Christ who left His imprints on this cloth, with a vivid record of the drama of Calvary, and with His true likeness hidden in the stains till photography revealed it again to the world.

**BEFORE publication of the accompanying article was undertaken, a survey of some of the sources of information as presented elsewhere was made —sufficient, it was believed, to justify publication. (Rev. Herbert Thurston, opponent of the Shroud, states in the "Catholic Encyclopaedia" that many articles have been published concerning the Shroud. Of books there are: Beecher, "The Holy Shroud;" Barnes, "The Holy Shroud;" Vignon, "The Shroud of Christ;" Hynek, "Science and the Holy Shroud.") However, publication must not be taken to imply that this magazine takes sides with regard to the question of the Shroud.—*The Editor.***

Though the main question is believed to be settled, the Shroud still presents some scientific difficulties. One of these is the fact that the rendering of the face is much more perfect than that of the rest of the body. It is finer, more detailed, more precise—so much so, in fact, that when the scale of values is reversed by photography, this "death-mask" stands out with the harmony and the contrasts of a living face—majestic, forceful, and still retaining an expression of deep sorrow. Why the imprints of the face should have such a superior quality, and how so startling an effect could be produced by such simple means as vapors reacting with aloes, is something which we have not yet been able to explain.

The clots of blood present another difficulty. Many of them had already dried on the surface of the body, and yet they were transferred to the Shroud. I account for this by the fact that the fibrin of coagulated blood dissolves in a humid ammoniac medium, such as surely surrounded the Body of Christ in the tomb. After the dry clots were sufficiently dissolved they were transferred to the Shroud. I have obtained similar prints of clotted blood on cloth in this way. What puzzles us, however, is the perfection of the clots which were transferred to the Shroud. They are so complete and so minutely exact that they may be called "portraits of blood." Though I carefully supervised my experiments and used small pieces of select cloth, I could obtain only imperfect prints, failing always either by excess or by defect. Here, on the contrary, all the clots, including the serum, are rendered with photographic accuracy.

One may ask, too, how the long sheet of soft linen could have been distended evenly enough to receive all those exact images of the reliquified clots. And why is it that the dry blood did not scale off from the cloth in the course of the centuries? It is still intact, even at those points where it accumulated in some quantity.

The clots which were transferred to the Shroud after being reliquified have the same color as the liquid blood which came upon the Shroud directly. This occurred, for example, where the blood flowed from the wound in the side after the Body was laid in the tomb.[4] This blood flowed over the side and across the arched loins, falling upon the little transverse creases in the Shroud. From the feet also liquid blood stained the Shroud directly, flowing along the soles toward the heels and onto the Shroud. This flow of blood resulted from the opening of the wounds by the extraction of the great nail, which pierced both feet at once. But the color of all this blood raises a new problem. It is a sort of dull carmine, whereas very old blood becomes brown. Here, then, is another riddle, but not an objection. The more perfect and minute all the stains and particles of blood are, and the more closely we can analyze them, so much the more is it impossible to represent these things in a painting, or to reproduce them by any artificial means.

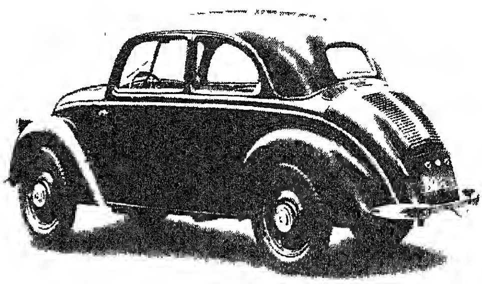
I HAVE given only a hint of the vast field which the Shroud opens to the investigation of science, archeology, and history. I could give other data on these marvelous imprints, and point out other difficulties still to be solved. There is room for further research along many lines; but though the difficulties may remain, they leave unshaken the important fact that the Shroud bears the imprints of Christ, bringing to us from the distant past the true likeness of Him who so profoundly stirred the world and influenced the course of history.

[3]The Shroud is 3 feet 7 inches wide and 14 feet 3 inches long. It was once longer, for the Emperors of Constantinople distributed as relics pieces cut off from the ends.

[4]This was a second flow of blood from the side, and it came from the *vena cava inferior*. The first flow, from the right auricle of the heart, came immediately after the stroke of the lance. It caused the dark stain on the front of the body, having clotted there while the dead body was left hanging on the cross.

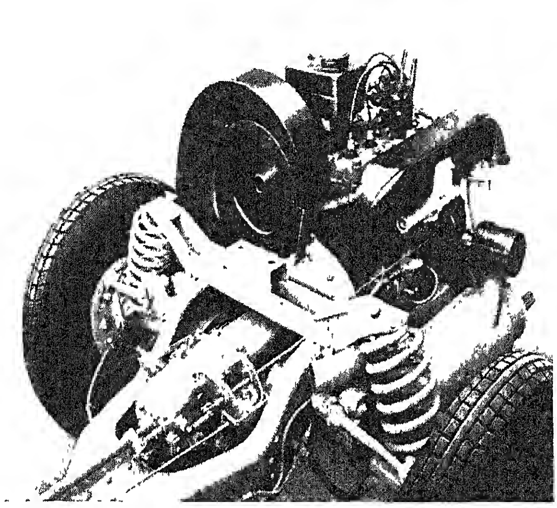
# TUBULAR FRAME- REAR ENGINE

## All Four Wheels Have Independent Springing . . . Engine, Transmission, and Differential In One Unit

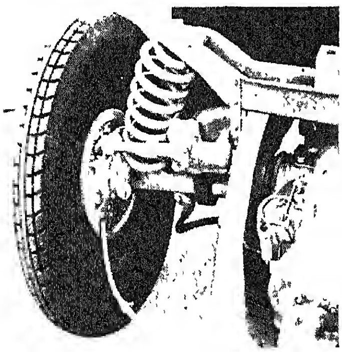


The smooth curves of the partially streamlined body of the Mercedes-Benz, type 170H, are made possible by placement of the engine in the rear. Under the front hood is the fuel tank, spare tire, and baggage space. Behind the rear seat is additional space for other baggage

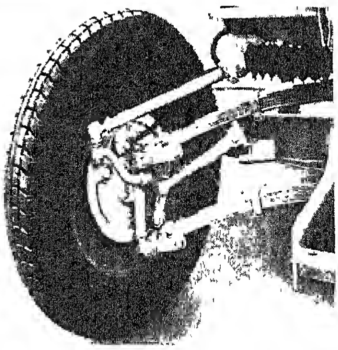
A EUROPEAN motor car now available on the American market has many features that recommend it as a decided advance in the design and construction of automobiles. It has no frame in the generally accepted sense of the word; a tubular member with a fork at rear end and three cross members serves to support the body and engine as well as supply spring anchorages for the wheels. The conventional propeller shaft has been eliminated, drive being direct from the engine through the transmission and differential to the rear wheels. Universal joints in the rear axles make possible independent springing of the rear wheels. A fume-proof and sound-proof partition separates the engine from the body interior.



*Left:* Under the rear hood is the power plant with the four-speed transmission and differential in one unit. The motor is water cooled and develops 38 brake horsepower

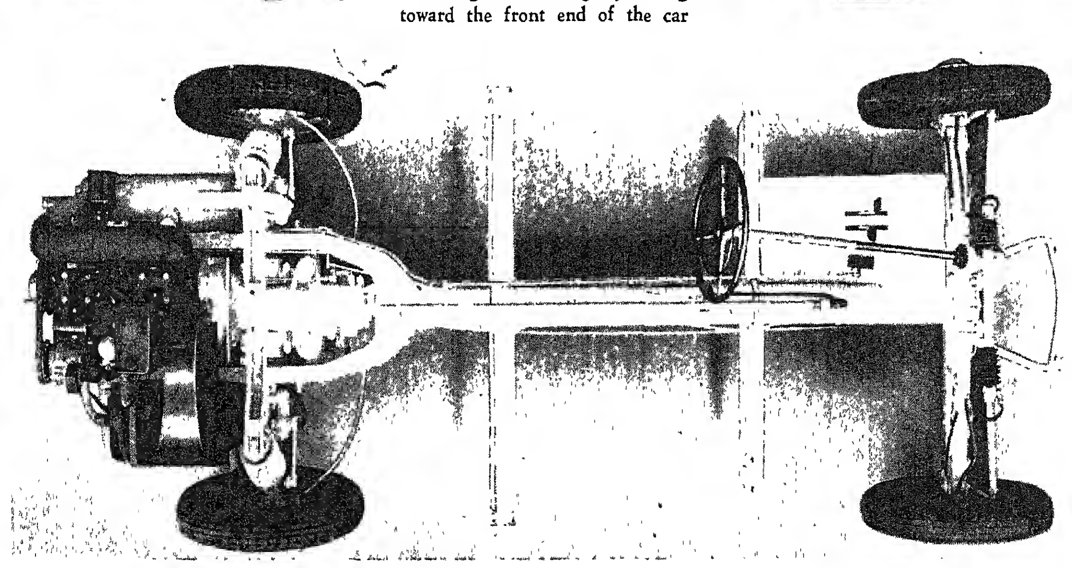


*Left:* Spiral springs support the independently sprung rear wheels



*Right:* The front wheels are supported by two sets of flexible leaf springs. Hydraulic brakes are used

*Below:* A top view of the tubular chassis. All parts of the engine are easily accessible when the rear hood is raised. The radiator and fan are at the right of the engine, looking toward the front end of the car



# THE ANALYSIS

## *Progress is Being Made in the Detection of New Solar Elements by Means of the Spectroscope . . . Osmium, Iridium, Thulium Now Added to the List*

By HENRY NORRIS RUSSELL, Ph.D.

Chairman of the Department of Astronomy and Director of the Observatory at Princeton University. Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington. President of the American Astronomical Society.

THE analytical chemist, who seeks in his laboratory to determine the composition of a specimen of rock or mineral, and the astronomer, who attempts with his spectrograph a similar analysis of the atmosphere of the sun or of some distant star, employ very different methods. Nevertheless, their problems, their difficulties, and their successes have a curious resemblance.

Were it not for one great handicap, the astrophysicist would have the best of it. The chemist's first task is to "open up" his mineral—to get it completely into solution without losing any volatile constituent, or missing any small insoluble residue. Only when this is accomplished can he apply his systematic scheme of tests. But nature "opens up" the material of a star completely, by making the star so hot that even the most refractory substances are volatilized, and the atmosphere contains everything that there is to seek. Moreover, the chemist, having obtained his solution, must apply successive tests for the different elements—some of them simple and very precise, others laborious and less sensitive; but when once the spectrum has been photographed, tests for the presence of all elements can be made directly and in the same way. The spectroscopic test, too, is often more delicate than the chemical. Indeed, for some rare elements such as scandium, which exhibit no strikingly distinctive reactions, no satisfactory chemical methods have yet been developed for detecting the presence of small quantities in complex mixtures such as ordinary rocks, while spectroscopic analysis, in the hands of Professor Goldschmidt, has been fully successful.

The handicap, of course, is the opacity of the earth's atmosphere to all the shorter waves of ultra-violet light, which hopelessly obscures the most interesting and important region of the whole spectrum from our view. If there were elements which had no spectral lines at all except in this inaccessible region, the chemist would have a complete advantage. But—fortunately for astronomy—practically all the elements show some lines in the observable region. Spectroscopic tests are thus possible, but in many cases insensitive. Chemical tests, too, are much less sensitive for some elements than for others; so, at the last, honors are fairly even, with the chemist ahead in some cases.

At this point the writer hears an imaginary chemist remark, "But how about all the cold bodies in space—from the moon outward—for which you can make no spectroscopic tests at all?"—and is moved to reply, "Go and get a piece of the moon yourself, and you'll beat us hollow." In all fairness it may be added that the spectroscopic analysis of meteorites—though possible in several cases, where they have been caught as they flashed across the field of photographs with an objective prism—cannot compare in detail with what the chemist has done with fragments picked up after they have fallen.

The sun is the best of all objects for spectrum analysis, primarily because it is so bright. For once—and only for once—the observer has almost as much light as he wants, and can use instruments of sufficient power to reveal practically all that there is to be found. Instruments of lower resolving power—such as must be used on all but the brightest stars—fail to separate the closer pairs and groups of lines. The great spectrographs which can be used on the sun are powerful enough to reveal the natural width of the lines of the spectrum—which, by the very principles of physics, are not absolutely sharp. Tenfold greater resolving power, though it would give us much desired information about the natural widths of the fainter lines, would not help materially in separating the extremely close pairs that we know often exist. Such lines would remain blended as a result of their own slight diffuseness, however great the instrumental power.

How, then, can we know that such close pairs exist? There are dozens—probably hundreds—of cases, in which (by pure accident) a line in the spectrum of one metal happens to have very nearly indeed the same wavelength as a quite independent line of another metal. With both metals in the arc at once, the superposed lines could not be separated by the most powerful spectroscope. But the kind aid of the chemist (who is here indispensable to the astronomer) provides us with pure samples of each metal separately, and we can measure the position of each line unaffected by the other. Now (if the line is not lop-sided), the position of its center can be measured to within about one percent of its width; and we may thus prove that the lines of the two elements are really not coincident, even though the two, if simultaneously present, would be hopelessly blended.

TABLE I

| | | |
|---|---|---|
| Hydrogen | Manganese | Barium |
| Helium | Iron | Lanthanum |
| Lithium | Cobalt | Cerium |
| Beryllium | Nickel | Praseodymium |
| Boron | Copper | Neodymium |
| Carbon | Zinc | Samarium |
| Nitrogen | Gallium | Europium |
| Oxygen | Germanium | Gadolinium |
| Fluorine | Rubidium | Dysprosium |
| Sodium | Strontium | Erbium |
| Magnesium | Yttrium | Thulium |
| Aluminum | Zirconium | Ytterbium |
| Silicon | Columbium | Lutecium |
| Phosphorus | Molybdenum | Hafnium |
| Sulfur | Ruthenium | Tungsten |
| Potassium | Rhodium | Osmium |
| Calcium | Palladium | Iridium |
| Scandium | Silver | Platinum |
| Titanium | Cadmium | Lead |
| Vanadium | Indium | |
| Chromium | Antimony | |

*The 61 elements thus far detected in the sun with the spectroscope.*

The first stages of the analysis of the sun were easy enough. So many or such strong lines of iron, calcium, sodium, magnesium, and hydrogen (for example) agree perfectly with solar lines that there was never any question of their presence. But when the analysis was extended to the fainter lines and the less abundant elements, things were by no means as simple. To begin with, in the olden days there was no generally accepted and accurate scale of wavelengths, such as we now use to define the position of the lines. When Rowland made his classic study of the spectrum, 40 years ago, he met the question by a direct frontal attack—photographing the spectra of the sun and of the element under consideration side by side on the same plate. Coincidences—or failures—were then obvious; but care

# OF THE SUN

had still to be taken in interpreting them.

If a few of the weaker lines of the laboratory source coincided with solar lines, but the stronger lines did not, it was obvious that the element was really absent from the spectrum, and that the observed agreements were accidental—as is indeed likely to happen now and then among 20,000 solar lines. If, however, the stronger laboratory lines agreed with weak solar lines, the absence of faint lines in the sun was not alarming.

In this way, with infinite pains, Rowland at last arrived at a list of 36 elements which he regarded as definitely present. Forty years of further research has not disproved a single one of these identifications.

Many additional elements have been added since that date. Three elements, helium, lutecium and hafnium, discovered on earth since 1896, have been detected also in the sun. Some familiar elements—nitrogen, oxygen, phosphorus, sulfur—show solar lines in the infra-red, observable on modern plates but not in Rowland's days. Others—boron, fluorine—reveal their presence by band-lines, due to compounds. Three—lithium, rubidium, and indium—show their strongest lines faintly in the spectra of sun-spots. A longer list, mostly of rare elements familiar only to chemists, has been added as the photographs were measured with sufficient accuracy.

The latest stage of the advance has just been reported to the American Astronomical Society by Miss Charlotte Moore, the recognized authority in this field. Three new elements are added to the list of those whose lines are definitely present in the solar spectrum—raising the number to 61. These all fall into the last of the groups just mentioned. Osmium and iridium are well-known elements, with spectra enormously rich in lines. Recent accurate measures by Dr. Albertson—much more precise than any which previously were available—show that the strongest line of osmium agrees with a faint solar line, not otherwise identified. Four or five other lines which might serve as additional tests are either masked by stronger lines of other elements or blended with similar weak lines. For iridium, the situation is substantially similar. Both elements appear to be present in the sun, but evidently in very small proportions. This is reasonable, as they are among the rarest elements on earth.

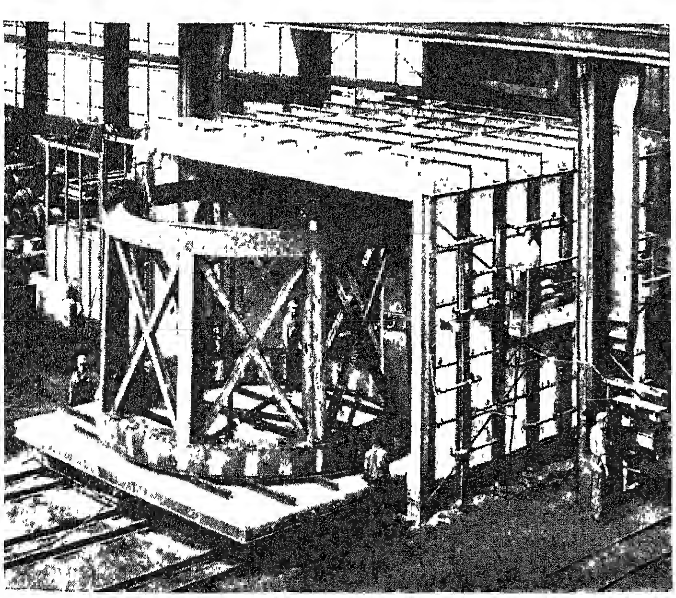
Thulium is one of the rare earths, which are notoriously difficult to separate. It is only very recently that reasonably pure compounds of this element have been available for spectroscopic study. With the aid of measures by Dr. Meggers of the Bureau of Standards, and Dr. King of Mt. Wilson, Miss Moore finds that four of the strongest lines appear weakly in the sun (while seven others are masked by, or blended with, lines due to other atoms). Here the evidence is conclusive. In this case the observed lines are due to the ionized atom (as is that for all the rare earths, which are very easy to ionize).

It is remarkable how large a majority of the lines of these elements are confused with lines of other substances—but hardly typical, as osmium and iridium represent the hard cases—left over after the easy ones have been disposed of—in which the complications are abnormally great. A little more in the way of chance coincidence would have left the problem insoluble, with all the important evidence suppressed.

The list of solar identifications, Table I, is now nearly, but probably not quite, complete. Better measures are still needed for two of the rare earths—terbium and holmium—and in the very rich spectra of thorium and uranium. The most curious case of all is a familiar metal, tin. This has four good lines in the accessible part of the ultra-violet. Two of them are quite drowned out by iron lines. Another may be masked by a strong line of chromium; but the existing measures, which were made more than 20 years ago, are not precise enough to settle this. The fourth line has been recorded faintly in the arc spectrum of iron; but is it by no means easy to get iron quite free from a minute impurity of tin, and it is still uncertain whether the observed line is due to such an impurity, or to the iron itself. We must wait—not long, we hope—until accurate measures are made on the spectrum of pure tin, and also upon exceptionally pure iron, before we know whether or not there is tin in the sun.

There are still 16 elements whose lines have not been found in the solar spectrum—not counting five radio-active elements which could not possibly be present in sufficient amounts to show. For 12 of the 16, the "absence" is to be blamed upon the ozone in the upper air, which cuts off the ultra-violet light. The strong lines of all these elements lie in the inaccessible region and the observable lines are absorbed only by atoms in highly excited states—loaded with energy to an extent which, even at the sun's high temperature, would be found on the average in less than one case in 10,000 (sometimes not once in a million times). Our spectroscopic test is here inadequate. Could we get at the proper part of the spectrum, we would probably find lines of most of the "missing" atoms.

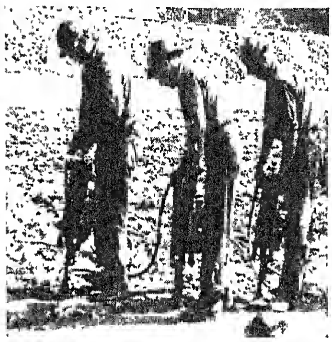
There are three metals, however—rhenium, thallium, and bismuth—whose strongest lines are accessible, and do not appear at all in the sun. These elements, if present in the solar atmosphere, must be excessively rare.—*Princeton, January 5, 1937.*

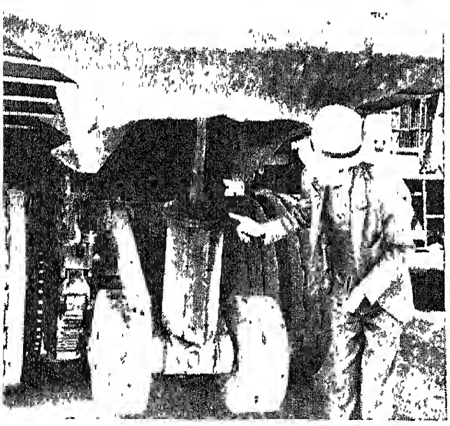


**The structural steel cage for the upper end of the tube of the 200-inch telescope being run into an annealing oven at the big Philadelphia Westinghouse plant. Inside this cage, which rotates, and supported on four knife-edges, will be the prime focus unit chamber, six feet in diameter, housing the secondary mirrors and the astronomer who will "guide" the photographic plate during its exposure**

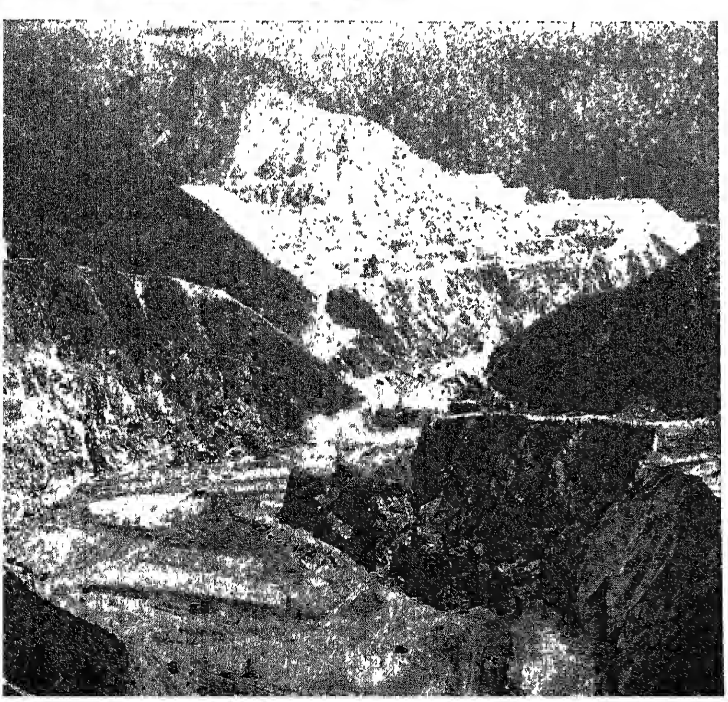
# Rock-Fill Dam

**Largest of its Type for the Purpose . . . Built in Six Zones . . . Compacted With Water . . . Huge Trucks Used . . . Gasoline-Operated Tampers**





**_Upper left:_ As trucks unload rock on the dam, streams of water are played on the surface to help compact the material. _Above:_ Gasoline tamping hammers, fed from a central storage tank, are used for the final tamping of parts of the dam. _Left:_ Dumping mechanism on the rear end of one of the huge trucks used for carrying materials. Hydraulically operated, it prevents the shifting load from lifting the front wheels. _Below:_ Looking downstream at the dam-site; quarry for rock used in dam is at upper center**



"COMPACT the rock," is the watchword of workers who are speeding to completion San Gabriel Dam No. 1 in the deeply ravined San Gabriel Canyon, 30 miles northeast from Los Angeles, California. This rock and clay structure will be, when completed, the world's largest of the type ever undertaken for flood control purposes. Built under supervision of the Los Angeles County Flood Control District at a cost of 12,500,000 dollars, the dam will contain 10,641,000 cubic yards of rock.

Sudden floods of the past have inflicted damage estimated to exceed 160,000,000 dollars to property below the dam-site. Then, too, the region contains many earthquake faults. Therefore, engineers reasoned, a structure relatively safe against both hazards must be provided. The rock-fill dam, replacing a masonry dam started earlier, is their answer.

THE dam measures 1950 feet thick at the base (having a three to one slope on both upstream and downstream faces), tapers to a 40-foot width at the crest, is 1540 feet long at the crest, stands an average of 375 feet high above bedrock, and is being built in six zones.

Zone 1 serves as a dumping ground for the finest material blasted from a nearby quarry. This includes some coar good rock. It is covered with clay at water face. As the rock is put in pla it is "sluice filled"; that is, two cub yards of water for each cubic yard rock are applied for the purpose of compacting the rock.

Zone 2 consists largely of sandy loam, which will seal the structure against percolation. It will be protected against wave action by Zone 1, which likewise is sufficiently porous to prevent Zone 2 from drying out.

Zone 3, the core section, consists of compacted quarry material screened to a size no larger than six by nine inches. This zone is rolled and tamped at frequent intervals and water applied to aid in the compaction. In place, the rolled-tamped rock of Zone 3 weighs 150 pounds per cubic foot, or about the weight of concrete. This represents the most novel feature of the dam: rolling

# For Flood Control

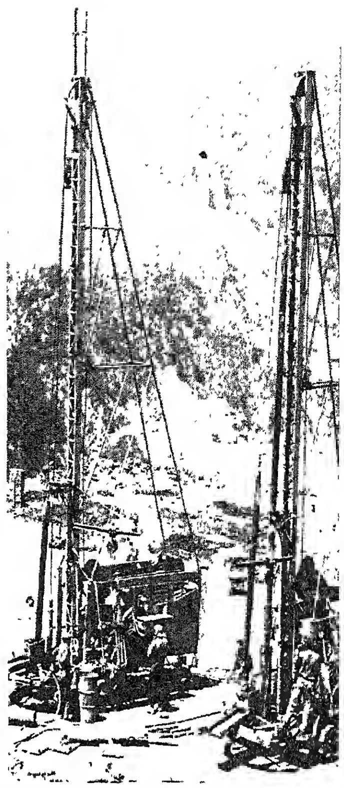
By ANDREW R. BOONE

rock to secure compactness. Dual sheepsfoot rollers are employed. They were designed especially for the job. The rollers are placed in parallel in a metal frame and hauled by tractors. Through their use the rock is compacted to about two thirds its freshly-dumped volume. After rolling and tamping—the latter accomplished by hammers powered by tiny gasoline engines fed from a central fuel supply and fired by portable electric batteries—the rock of Zone 3 shows a very high shearing strength, as well as very low permeability.

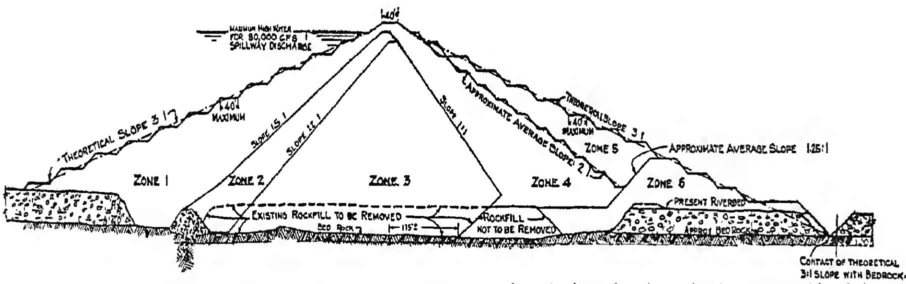
Zones 4, 5, and 6 consist of sluiced rock fill. Rock in these zones is so graded that the zones become progressively porous toward the downstream face. Zone 4 contains quarried material of all

by six blast-hole rigs capable of sinking eight-inch holes to a depth of 60 feet. Trucks, largest ever built for construction work, carry 25 cubic yards of material. So heavy are the loads that a semi-retractable dumping mechanism is provided. This consists of two steel rollers attached to the rear under-portion of the trucks by means of a hydraulic jack. Trucks are dumped by lowering the jacks slowly.

The dam will have a capacity of 60,000 acre-feet at the spillway level; 70,000 acre-feet at the crest. The spillway will cut through rock at the canyon's edge, will be capable of handling 80,000 second-feet with a residual freeboard of 15 feet, equivalent to 250,000 second-feet before overflowing the dam proper.



Two of the drills that sink eight-inch hol feet deep, which are then packed with dyn in order to blast away benches of rock



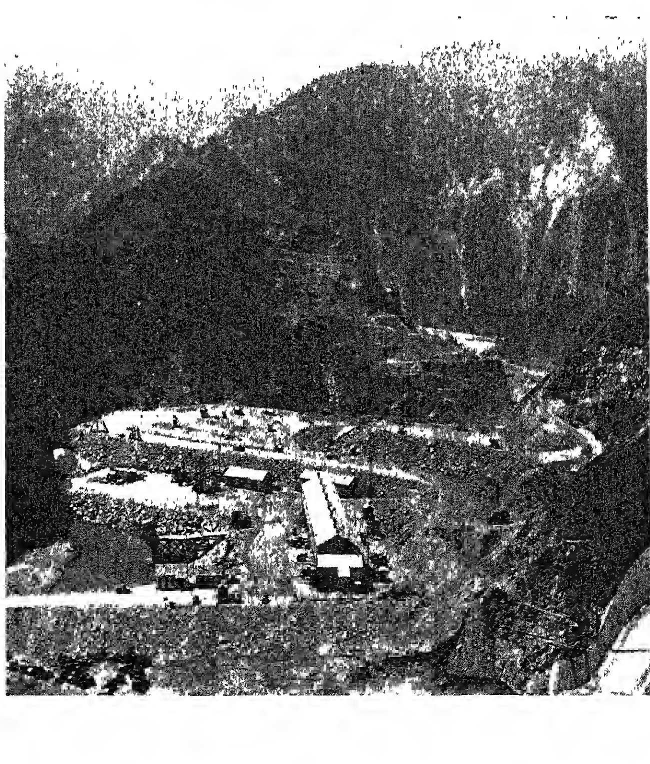

Cross-section drawing of the finished dam, showing the relative masses of the six zones which will constitute the completed structure, and which are detailed in the text

*Below:* A view taken from the downstream side of the dam-site c ing an early stage of construction, giving an excellent idea of magnitude of the project. Note 30-foot diversion tunnel at ri

sizes; Zone 5, rejects from the grizzly, mostly rocks of one half cubic yard or larger; Zone 6, high strength rock of the best available quality, which forms the base for the sluiced zones.

The structure is made water-tight by a combination of Zones 2 and 3 with a concrete cutoff wall skirting the upstream side of Zone 2 which extends into bedrock to a maximum depth of 80 feet. Crevices are grouted to a maximum depth of 150 feet, thus shutting out the water from those sources. Faults of whatever nature are separately treated to a depth equalling one half the static head of water on top of bedrock at those locations, or to a maximum depth approximating 100 feet. Further, Gunite six inches thick is applied under Zone 2 along its contact line with the abutments.

NEARLY all operations at the dam-site are electrically powered. Shovels are full-revolving, Caterpillar mounted, and equipped with four-yard buckets. Benches are drilled for shooting



## A Photographic Laboratory "Tool" With Which You Can

# ENLARGE—PRINT—RETOUCH

### A Commercial Unit Made at Home . . . Materials Easily Obtainable . . . Uses Photoflood Bulbs for Light Source . . . High-Speed Enlarging

By HERBERT E. HAYDEN

Photographs by the author

ALMOST every photographic enthusiast is familiar with the usual projection enlarger of the vertical type, in which the negative is held in a carrier some distance from the bromide paper on the easel below. With a suitable illuminant and lens system, the image is projected downward on the paper.

The apparatus described below (while distinctly home constructed) differs in comparison with the vertical enlarger of the usual type, in that the negative is illuminated from below, the projection being *upward* on a focusing screen. No originality is claimed by the author, as this is indeed a home-made copy of an enlarger* that is made commercially in more perfect form. As the photographs and illustrations herewith will prove, the construction is almost identical with the factory-made product.

In addition to its virtues as an enlarger, the instrument also functions, without change, as a photographic printer for contact prints and as a retouching desk for working on negatives or examining transparencies such as "trans-lite" prints on paper or film.

To describe the construction in infinite detail would result in an article of considerable length, so actual photos of the apparatus were made during the process of construction to enable the reader to duplicate the machine quite easily.

The complete apparatus (Figure 1) may be considered as being made up of separate units, as follows: 1. The telescoping case. 2. The enlarging head. 3. The focusing panel top with platen. 4. The lamp house and electrical system.

*The Graflex Enlarg-or-Printer, manufactured by the Folmer Graflex Corp., Rochester, New York.—*Editor.*

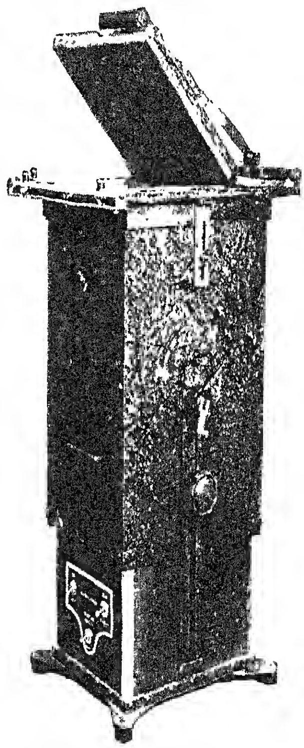


*Figure 1:* The finished unit ready for use as an efficient enlarger

The telescoping case is made in two sections, the lower section containing the lamp house, negative holder, and enlarging head proper. It measures $8\frac{1}{2}$ inches wide and 10 inches from front to back. The height is 20 inches, with a cut-out "V" section on the left side $3\frac{1}{2}$ inches from the top for convenience in changing lenses.

The top section of the case which telescopes down on the lower one, and thus decreases or increases the projection range or size of enlargement, measures $8\frac{5}{8}$ inches wide and $10\frac{1}{2}$ from front to back. It is provided with a [illegible] ing glass table top made in the style of an ordinary contact printing frame in which the bromide paper will be placed face down.

Half of the lower section is taken up by the lamp house (Figures 2 and 3) which measures 10 inches high and is made of two pieces of maple $\frac{1}{4}$ inch thick. Four holes, $1\frac{1}{4}$ inches in diameter and $6\frac{5}{8}$ inches from the base, are for ventilation. Later in the construction, the wooden boards are backed up inside with sheet asbestos, and painted with aluminum paint.

The top of this boxlike arrangement has a platform made of $\frac{1}{4}$-inch thick hard asbestos sheet, over which an 18-gage steel plate is firmly affixed, using brass angles. A four by five inch opening is cut through this, centered, and forms the light aperture over which the negative holder will slide. Two pieces of one inch channel brass are secured to the sides and form a hold-down for the projection head platform which will be attached later. (Figure 6.)

An underside view of this lamphouse section is shown in Figure 3, with [illegible]

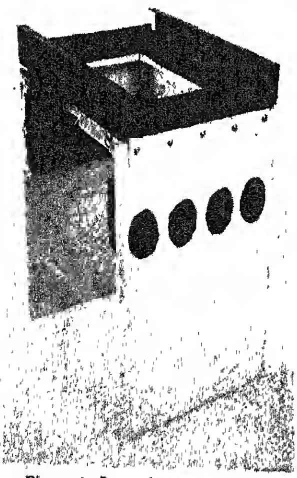


*Figure 2:* Lamp house under construction. Holes are for ventilation

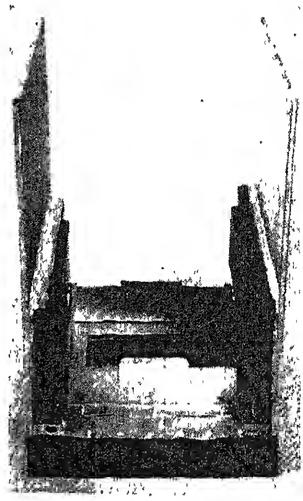


*Figure 3:* The lamp house inverted, showing light traps painted black

ventilating light traps, of bent up aluminum painted dead black, installed with small nails along the edge. Around the center cut-out section, and $1\frac{1}{4}$ inches from the lower surface, a frame of thin aluminum is bent up as shown to hold a standard piece of five by seven inch opal glass for diffusing purposes. This frame is purposely made large enough so that the glass is free to "jiggle" in its housing as it will expand when heated and certainly crack if it is clamped in tightly.

A second 18-gage steel plate with an opening four by five inches and matching the one just described is fitted with the bellows taken from an old camera, and with a front standard to hold removable lens boards. (Figure 4.) The L-shaped construction of this unit makes it easy to affix two $\frac{1}{4}$-inch steel rods, seven inches long, with sliding bearings for the lens standard, so that upward or downward movement is smooth and steady. This movement is made possible by means of a standard $\frac{1}{4}$ x 20 threaded nut soldered to the front of the lens standard, through which a seven-inch piece of $\frac{1}{4}$ x 20 threaded steel rod is passed and held at its upper and lower ends in suitable bearing sockets, free to rotate.

Every complete turn of this rod moves the lens up or down in a vertical line exactly 1/20 of an inch, making extremely fine focusing possible. Moreover, it is not necessary to lock the lens standard in any position as it will not budge until the rod is deliberately revolved. Motion of the lens standard is accomplished by fitting a pair of mitre

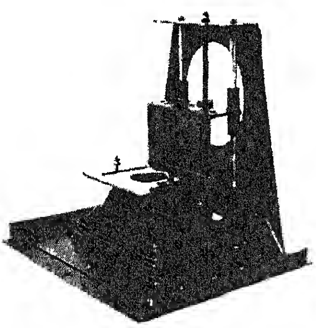


*Figure 4:* **Projection head to be mounted on top of the lamp house**

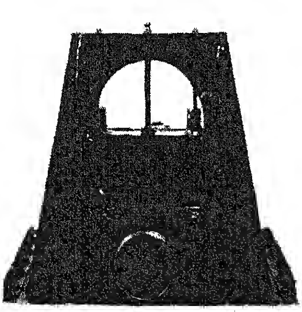


*Figure 5:* **Control side of projection head: adjusting knob in place**

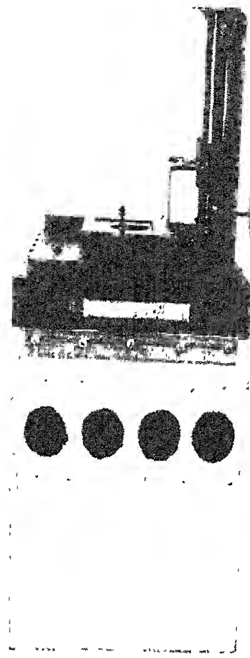


*Figure 6:* **The lamp house and projection head completely assembled**

gears, 1:1 ratio—$\frac{1}{4}$-inch centers, one of which is fastened to the threaded rod at the base. The other is fitted on a $1\frac{1}{2}$-inch length of $\frac{1}{4}$-inch rod, which passes through a hole in the vertical section and extends out horizontally through the case on the right hand side. When the knob that is fitted on the other end of this short shaft (Figure 5) is turned by hand, the lens board rises or falls vertically—and *stays put.*

Small pieces of sheet aluminum are used as lens boards, two holes at the outer edges slipping over 6/32 studs on the lens standard, and are held in place with thumb nuts. Lenses of two- and three-inch focus are used. These may be standard camera lenses, or lenses made especially for enlarging, such as the "Kino-Hypar" or the Schneider "Componar."

The next step in construction is to build up the side pieces of the lower section. These are cut out of 18-gage black crackle-finished steel, obtainable in large sheets at most radio supply stores. These side pieces are attached to the wooden sides of the lamp housing with one-inch #4 flat-head wood screws. The large hole (Figure 7) is four inches in diameter; the slots permit insertion and removal of the opal diffusing glass. When the apparatus is in use, this hole is kept closed and light tight by the circular twist-on cover. The cover is provided with suitable handle of simple design.

The base of the instrument (Figure 8) is constructed of the steel sheet mentioned above and is provided with upright angles over which the lower section of the enlarger is slipped and screwed fast with #6 Parker-Kalon screws. The elevated platform containing the three lamp sockets is made of 18-gage sheet aluminum, frosted finish. The two lamps installed in the exact center are Photofloods, the one slightly to the rear, a 25-watt red bulb. The small metal panel (Figure 8) is the switchboard of the outfit, the master switch turning on and off *all* lamps, the switch to the right turning on both Photofloods in parallel when in the "bright" position, or both lamps in series when in the "dim" position. (See Figure 10.) The switch at the left turns on the Photofloods whether the setting is at dim

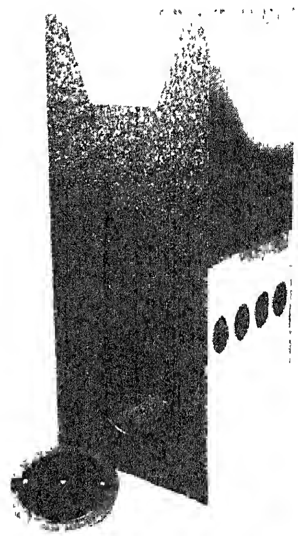


*Figure 7:* **Lower section of the case assembled around the lamp house**

or bright, and is used only for focusing and composition of the enlargement. Cross connected to this switch, however, is a second one on the top of the platen. This is so arranged that when the platen descends and holds the bromide paper against the glass, the Photofloods which make the exposure are turned on; upon release of the handle, these lights are extinguished. The red light remains "on" at all times and it is turned off only by the master switch. This safe light is used for placing the paper properly with regard to the sliding marginal masks, or for setting the negative properly when the machine is

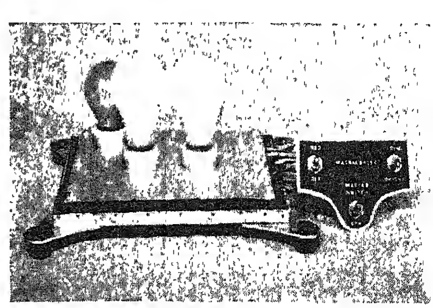


*Figure 8:* **Base of the unit, with lamps mounted. Control switches are on panel at right**

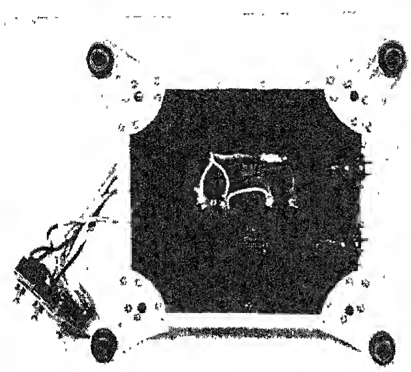


*Figure 9:* Bottom view of base, with split connectors at right. Hole is for ventilation

being used for regular contact printing.

The switches used are of the "toggle type"—a double-pole double-throw for the "dim-bright" connection and single-pole single-throw for the others. The one installed under the handle on the platen is a "trigger type" as used in electric hand drills and is fitted with a spring so that it must be held down manually in its "on" position, but instantly springs open when released. Commercially it is known as a "momentary control" switch and is obtainable at electric or radio supply shops.

Using two sources of light as an illuminant in an enlarger is looked upon by many authorities as rather poor design, since, it is argued, no two bulbs can be expected to give the same brilliancy; indeed, a light meter would probably prove this contention. It is

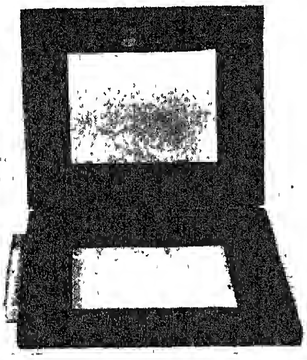


*Figure 11:* Negative holder with cut-out sections and flat spring fingers

also quite true, however, that opal and other diffusing glasses are not equally translucent at all points, so that a variation in this sense could be expected with a single illuminant under any conditions.

In any event, the results seem perfect enough with the two lamps, but, if desired, one Photoflood may be used, centered under the negative opening, and the dimmer provided through an external resistance, put into the circuit by a suitable switch, as it is in the commercial machine of which this is a copy.

The extra lamp will be welcome, however, if very dense negatives are encountered, or if the slower enlarging papers are used, as well as when giant enlargements are made by projecting onto the wall.

A five-inch hole in the sheet-steel base (Figure 9) is for the purpose of ventilation. The wiring is brought out to the male side of the split connectors for further electrical connection, and to avoid trailing wires. All wires in the circuit are covered outside with a close knit wire protective covering, known in radio parlance as shielded

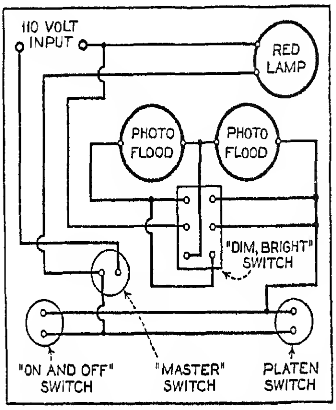



*Figure 10:* Wiring diagram of all the lights and switches in the unit

cable. The platen connector plugs into the line leading up the rear of the machine to the platen switch; the other connector is for plugging in the house circuit in the manner of plugging in any household electrical appliance. The extended feet of the base have soft rubber tips to keep the machine absolutely steady and prevent sliding on a polished floor.

The negative holder (Figure 11) is of the "book type," six inches wide and nine inches long. Each half is ½ inch thick. The opening is four by five inches,

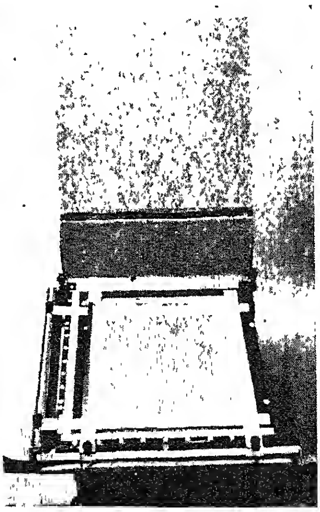


*Figure 12:* Top of completed unit, with focusing celluloid in position

and the recessed portion of the holder accepts two sheets of standard 5 by 7 glass including suitable masks. The upper half of the holder is provided with two spring fingers made of phosphor bronze which, when the holder is closed, keep an even pressure on the negative. Metal masks are used for certain negatives, and, if desired, a slot may be cut at each end of the holder, providing an easy pull-through path for Retina or Contax size negatives made on movie film.

The openings in both the lamp house and negative carrier are large enough to hold negatives from 35mm to five by seven inches, but the actual field from any negative to be enlarged is restricted to 2¼ by 3¼ inches or that portion of any negative up to five by seven. The holder automatically centers itself when slid into the opening provided, due to the guide rails placed on the side and at the rear.

The top section of the case is also made of crackle-finish steel sheet as shown. It is held in the desired position by a large bolt passed through the lower

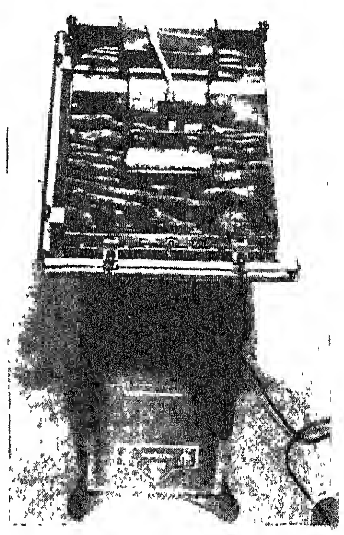


*Figure 13:* Platen closed. The platen switch is in box back of handle

part of the case and running in the slot in the extension piece soldered to the top section. (Figure 17.) A door in one side permits changing of lenses. (Figure 18.)

The tilting top is constructed by making a frame of suitable size to fit the top section of the case, and is supported on pivots front and back, so as to tilt from left to right. A hold-down metal strap keeps it in any wanted position by tightening the ¼ by 20 bolt which holds the strap to the case. The tilting top permits correction or distortion of perspective in the negative.

The sliding masking frame (to produce even, white margins) is made from old time radio tuning coil sliders, obtainable at most radio supply stores, and

¼-inch square brass rods over which these sliders travel. The contact shoe of the slider (in its original sense) is used as a tension spring and rides along on a frame made of 18-gage aluminum. Soldered to these sliders are lengths of thin brass ribbon which form the masking blades. (Figure 12.) The graduated scale over which they travel is also a radio product of older days, being made up from four celluloid scales formerly used on drum type tuning dials. These are cut apart and matched so as to give divisions in inches, half inches, and sixteenths. The large numbers are also cut

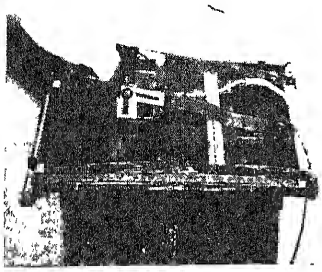


*Figure 14:* Operation of handle closes platen and turns on the lights

from the same drum dials, and are sunk into the wood surface.

For purposes of masking, the distances are measured using the center of the platen as zero or starting point, and the blades are pulled away from this point, thus masking off the bromide paper up to the limits of the platen.

The platen (Figures 12, 13, and 14) is constructed of half-inch wood on the style of a printing frame back, with a hinge extending all the way across. Fastened to this platen, on its under-side, is a soft ¼-inch thick felt pad which comes directly in contact with the bromide paper, forcing the sensitive side flat against the clear glass.

The long handle of the platen has #14 piano wire springs at four points. These are of a design resembling an open safety pin. Pressure on the handle causes these springs to hold the paper tight before the two Photoflood bulbs are turned on by the closing platen switch.

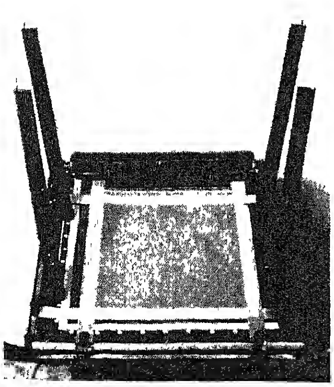


*Figure 15:* Extension arms fitted to provide for greater enlargement

At the rear, the platen is so hinged that it can be swung back and out of the way, allowing the use of an extension top which makes possible 11 by 14 inch enlargements. This is done by providing four posts, eight inches long, which screw into the frame of the 8 by ten inch platen already described, and a second bromide paper holder is thus available. (Figures 15 and 16.) In this case, the platen switch may be dispensed with, and the exposure light turned on with the toggle switch.

Focusing is accomplished by projecting the negative upward on a fine-grained sheet of celluloid, obtainable at most photographic supply houses. This is to be preferred to ground glass as it is unbreakable.

To make an enlargement, the negative is placed in the holder *face up*, using one of the masks to exclude all ex-

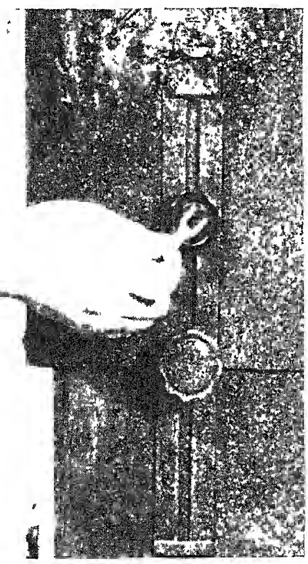


*Figure 17:* Focusing knob and the lock knob for upper sliding case

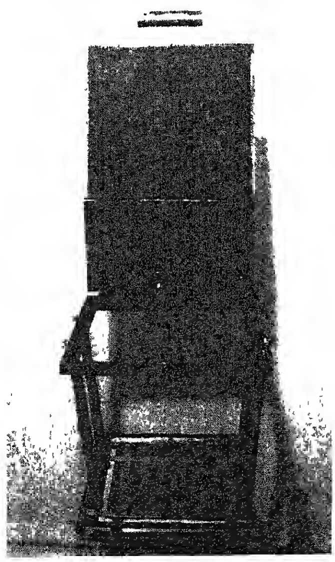


*Figure 16:* Frame for 11 by 14 paper fitted to the extension arms

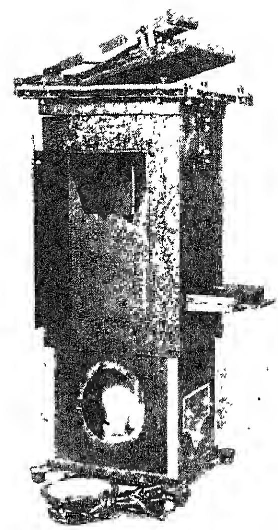


*Figure 18:* Completed unit, showing the two openings on the left side

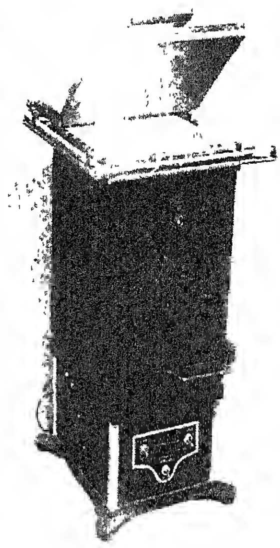
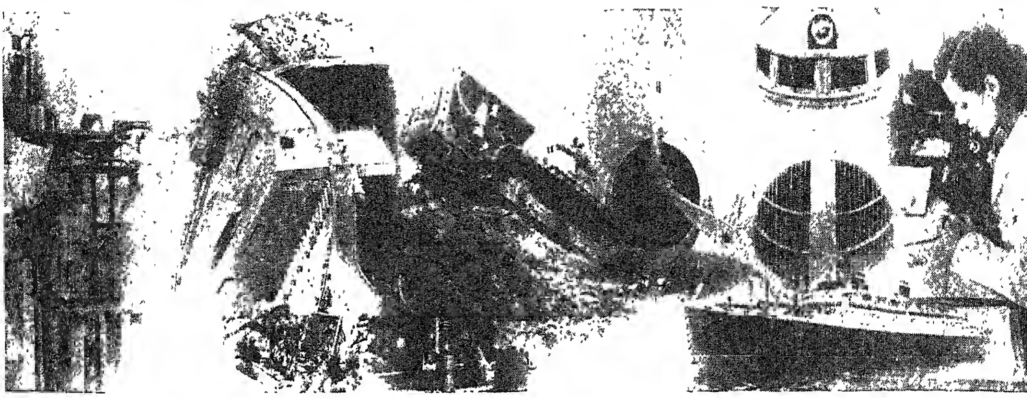


*Figure 19:* Front of the unit ready for use. Note the negative holder

traneous light. Focusing is then carefully done on the celluloid sheet. This sheet is then removed, the white lights turned off in the machine, a sheet of bromide paper is inserted *face down*, and the platen brought down. The speed of the machine is so great that the operation is almost like contact printing.

To use the machine for contact printing, remove the lens and board completely and lower the top section of the black case down toward the floor as far as it will go. Then proceed in the usual manner, treating the apparatus as an ordinary printing box.

As a retouching desk, use the glass surface of the platen, with the two Photofloods in series as the illuminant; or they may be replaced with two ordinary 60-watt bulbs, in this case leaving the switch on "bright."



# THE SCIENTIFIC AMERICAN DIGEST

Conducted by F. D. McHUGH

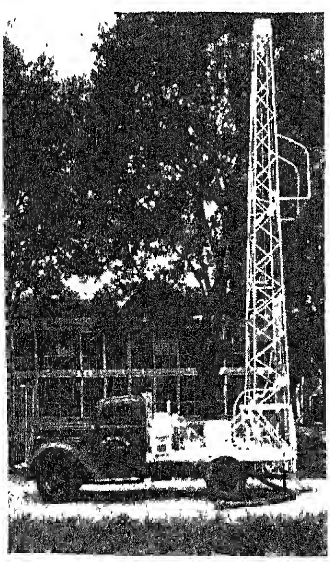
Contributing Editors

ALEXANDER KLEMIN
In charge, Daniel Guggenheim School of Aeronautics, New York University

D. H. KILLEFFER
Chemical Engineer

## Drilling Rigs on Truck Chassis

AVOIDING the delays and sometimes prohibitive costs of moving in and setting up a steam drilling rig, an ingenious, efficient, and thoroughly portable motorized drilling rig consists of a standard 1½-2 ton,



New drilling rig ready for use

Diamond T truck chassis and cab, with a derrick, rotary table, draw works, and mud pump.

Twenty-four of these portable drilling units, developed and built by the W-K-M Company, Inc., of Houston, Texas, are in active service of the Core Drilling Company, an associate enterprise, operating throughout the coastal plains region of Texas and Louisiana.

The rigs are capable of drilling a hole 1000 feet deep, and through the use of auxiliary equipment, winches, and leverages, are able to traverse almost inaccessible terrain—rough country without roads and with steep hills. As a matter of record, the trucks rarely use an improved highway. Some of the trucks are equipped with separate engines, although for the most part, power for operation of drill and mud pump is taken from the truck's own power plant using a split-shaft power take-off to provide drive for both drill and mud pump. Many of these trucks have drilled as much as 100,000 feet in addition to providing their own motive power, without any repairs whatever to the engine.

This portable drilling unit is suitable for all drilling activities, and has an extremely wide range of applications. Predominant, of course, is its use in exploratory drillings to depths of from 80 to 100 feet, a type of work essential to petroleum production, water search, and preliminary studies preparatory to beginning construction of bridges and building foundations.

In exploration of suspected oil-bearing territory, the drill truck is followed closely by a geographical prospecting crew, which does the "shooting," the results of which, recorded upon delicate seismographic instruments, indicate whether or not oil is likely to be found and, if so, at what depth.

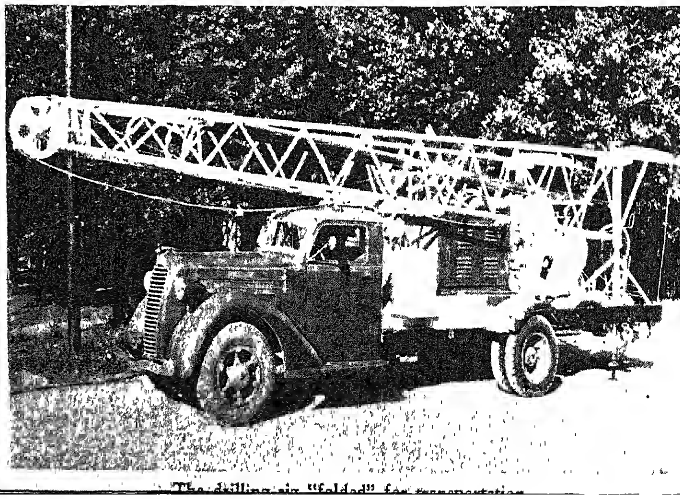
In operation, the unit is driven to the chosen site and parked. Using the truck's engine for power, the mast or derrick is raised, the drill stem quickly adjusted and the engine's power shifted to turn the drill, while at the same time the mud pump circulates the fluid to wash the cuttings from the hole as drilling progresses. For coring work, a larger unit and, of course, a truck of longer frame are required, as these core holes are drilled to depths of from 100 feet down to 2000 feet.

### ICE BUG

MOST insects are sluggish in cold or even cool weather, but not the *Grylloblatta campodeiformis*. This rare insect, commonly called the "ice bug," is happiest when it is near freezing, prefers a temperature of 38 degrees Fahrenheit, and suffers heat prostration at 80 degrees.

## Synthetic Scares

FREQUENT announcements from abroad of new synthetic products have continually caused momentary stirs in the lay mind, says *Industrial and Engineering Chemistry*, pointing out the disproportionate attention given such announcements. The statement continues: "Word, for example, that a chocolate bar which looks like soap but tastes like chocolate has been synthesized in Germany from coal-tar raw materials and actually marketed, appears at first to indicate that our foreign brethren still lead us in cleverness. However, when this and similar announcements are checked and their significance is evaluated, the impression is



The drilling rig "folded" for transportation

largely nullified. Similar agitation has been caused from time to time by reports of new synthetic rubber-like materials abroad, which often turn out to be more interesting than important; in this field particularly the United States, with at least two such synthetic materials in large-scale production and use, definitely leads the world. It is, however, difficult, if not impossible, under our economic system, to combat the false impression which such offhand announcements from abroad create in the public mind. Laymen generally are not in a position as chemists most frequently are to answer such announcements by the query, 'What of it?' More and more the real advances of industry based on scientific discovery in the United States are becoming everyday articles of commerce which the man in the street fails to recognize as synthetic. Yet the huge tonnages of synthetic products used in this country are daily increasing and their variety is widening at a rate far greater than can be equaled in any other country of the world."—*D. H. K.*

*New room-size air conditioner that plugs into a light circuit*

### WHALES

**DURING his period of most rapid growth the finner whale, which is the one most hunted for oil nowadays, increases in size every day by the equivalent of a big man's weight.**

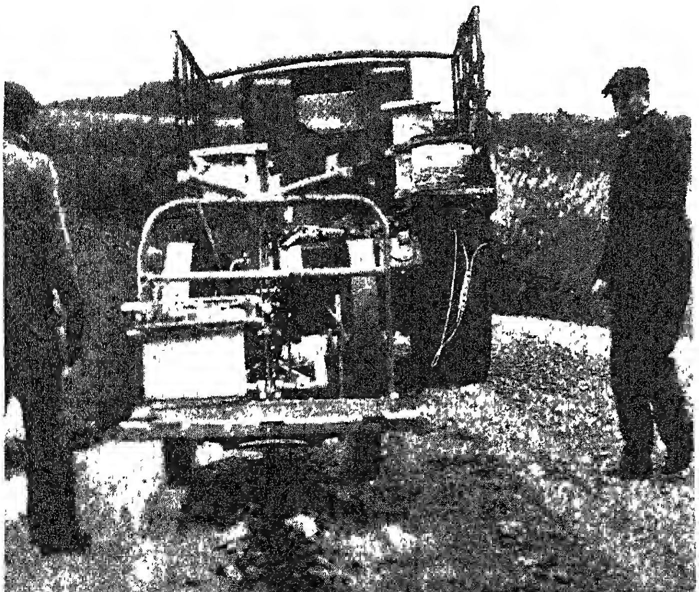
## Plowing Wires Into the Ground

PLOWING telephone wire into the ground as a new and effective method of constructing storm-proof rural lines has been recently demonstrated in certain sections of New York State. Insulated and protected by a special rubber coating, the wires are buried about a foot and a half underground along the shoulders of roads. They are thus protected against snow, sleet and wind storms, lightning, fires, and other hazards which may trouble overhead lines.

By the new method the telephone lines of 17-gage copper wire coated with tough rubber are planted by a special wire subsoil plow mounted on a two-wheel chassis, drawn by a tractor or a truck. From reels attached to the plow, the wire is fed directly to the bottom of the trench dug by the plow. The trench, being narrow, fills up easily and without marring the highway or the subscribers' grounds.

Under favorable conditions as much as four miles of line can be buried in a day. Over irregular terrain the progress is much slower. A crew of linemen and other telephone plant men is needed to operate the plow and do special splicing and construction work.

For many years the Bell System has steadily improved the service by placing its telephone circuits underground. But in nearly all cases, these placements have been made in cables which carry a number of circuits. In fact, more than 80 percent of the wire mileage of the New York Telephone Company in this state is thus buried in cables, while all but about 1 percent of the remainder is in cables overhead. Consequently the new method of burying an actual pair or two of wires along rural routes, where only one or two circuits may run for a considerable distance of poles, tends still further to cut down the remaining bit of open wire left along the voice highways.—*Telephone News Bulletin.*



*Courtesy Telephone News Bulletin*

Sub-soil plow, drawn by a tractor, buries telephone wires

## New Air Conditioner Becomes Plug-in Appliance

INTRODUCTION of a new window-mounted room cooler by Westinghouse that embodies ease and quickness of installation and inexpensive operation costs was reported by S. F. Myers, Manager of Air Conditioning Sales. Myers continued with the explanation that the new Westinghouse cooler could actually be installed in less than 25 minutes, thereby eliminating one of the principal objections to the purchase of room coolers.

This new summer air conditioner for bedrooms, dining rooms, medium size offices, hotel and living rooms, has been so perfected that preliminary construction work to install it has been completely eliminated. Installation is very simple; it is only necessary to open the window of the room about half way, rest the unit on the sill, place the cabinet in position, plug the cord into the nearest wall socket, and the cooler is ready for operation. The cooling and dehumidification which takes place during operation of the unit is equivalent to the heat absorption obtained by the melting of approximately one-half ton of ice every day.

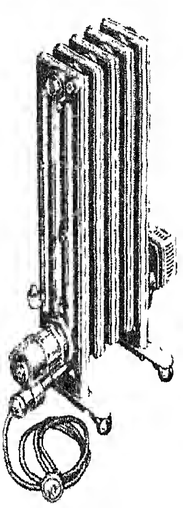
All of the air passes through an air filter before passing over the cooling coils, and with a portion of the "stale room air" always being expelled from the room into the atmosphere outside the window, cool, fresh, dehumidified air is always assured.

Other features of the new Westinghouse cooler are: an hermetically-sealed unit;

built-in "watchman" to guard motor against overheating; a compressor and motor cooled by refrigerant lines around the shell; a powerful oil pump that insures adequate and continuous lubrication; air filters to insure clean air; ventilating damper that permits exhaustion of foul air from the room; and a means of insulation that deadens noise, making for a more quiet operation. It is remarkably silent.

### Heat on Wheels

FOR all those odd little corners lacking heat but where warmth is still very necessary, a new portable electric steam radiator has been placed on the market. As our illustration shows, it resembles the ordinary



Heat where you want it

radiator, used commonly in the home, with the addition of an attachment cord and electrical heating element. It is on casters and is light in weight for moving up and down stairs. It is recommended for such difficult-to-heat spots as booths for police, ticket sellers, cashiers; for sun porches; and for camps.

The heater comes filled with the right amount of water containing a non-freezing fluid. It has a thermostat dial marked for a temperature range of from 55 to 80 degrees, while for special purposes a temperature range for as low as 35 degrees can be furnished. After it is plugged in, its operation is automatic. The current quickly converts the water into steam, heating the room by both radiant and convected heat. In addition to the thermostat control of heating, there is an automatic current shut-off which prevents trouble should high steam pressure be developed in the radiator.

This radiator, which is made by the Burden Industrial Appliance Corporation, is simple to operate, uses current only about 75 percent of the time, and, for the amount of heat furnished, uses relatively little power. It is built for use solely on alternating current systems.

### Steamotive—Packaged Power

THE design and testing of a new type of steam-generating unit of good efficiency, relatively light in weight and requiring minimum of space, was described jointly by the General Electric, Babcock & Wilcox, and Bailey Meter companies at a recent meeting of the American Society of Mechanical Engineers.

The new type of steam-generating equipment has been named the Steamotive. In it, steam is generated at high pressure and temperature; fully automatic control in response to changes in demand has been incorporated. The units are intended for capacities of from 2000 to 10,000 horsepower.

Two such units have already been built. The first, now in service in the Lynn, Massachusetts, works of the General Electric Company, is used to test marine and other small turbines. It has an output of 21,000 pounds of steam per hour at a pressure of 1500 pounds.

Another, a completely co-ordinated power-generating plant incorporating the Steamotive and turbine-generator, with a capacity of 10,000 pounds per hour and furnishing steam to a turbine at 1200 pounds per square inch and 950 degrees, Fahrenheit, is being installed in a small, isolated plant of a large industrial concern to supply electric power and low-pressure steam for building heating. Both are oil-fired.

Two oil-fired Steamotive units, each with a capacity of 40,000 pounds per hour, are now being constructed for the Union Pacific Railroad for driving two 2500-horsepower electric locomotives, it was announced at the meeting. These units will furnish steam to the turbines at 1500 pounds per square inch and 950 degrees, Fahrenheit.

Indicating the compactness of the Steamotive unit, the one for Lynn was shipped complete from Schenectady on a railroad flatcar.

Objectives sought in the design of the new equipment were pointed out as high steam pressure and temperature, minimum weight and size per unit of steam produced, wide range of capacity with ability of the unit to respond quickly to wide variations in load conditions, adaptability to a wide range of fuels, completely co-ordinated auxiliaries, completely co-ordinated automatic control, and units of simple design and constructed in sizes small enough to be portable.

In the operation of the Steamotive unit, the flame and gases pass from the burner through the completely water-cooled furnace, thence into the superheater, flowing around the separator, through the economizer and air heater, and up the stack. The air for combustion leaves the blower at relatively high pressure, passing through lanes intersecting the stack, and down around the air-heater tubes to the oil burner. There is no induced draft fan, the blower forcing the air through the burner and furnace under pressure.

The feed-water enters the economizer inlet header, and, after leaving the outlet header, is divided into several circuits, each of which form the floor, sides, and roof of the furnace, as well as the sets of loops forming the boiler screen. All the steam is generated in these furnace and boiler circuits, and enters the separator with a surplus of water in each circuit. From the separator, the dry steam goes through the superheater, and directly to the main turbine. The water from the separator is called the spillover, and it passes through a heat exchanger to the hot well, where it mixes with the condensate, and is re-fed to the boiler by the feed pump.

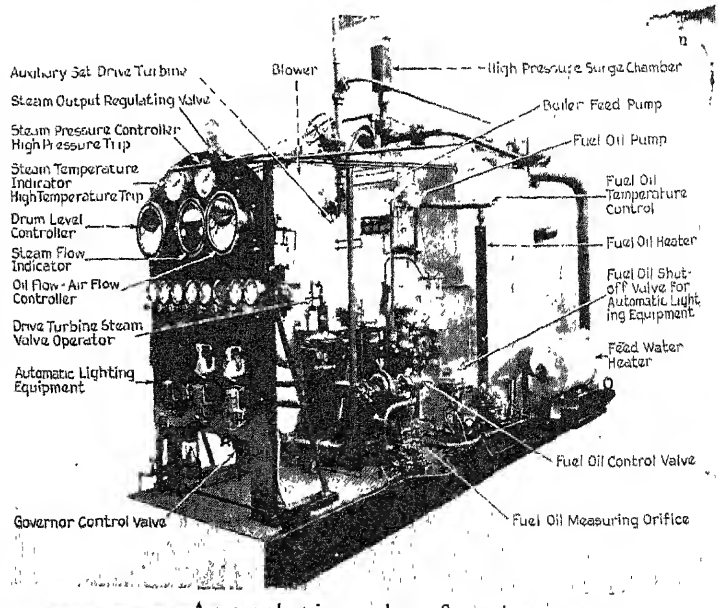
Due to the compact arrangement of the Steamotive unit, it constitutes what is practically a packaged power plant.

## TRANSPORTATION SECTION

### Highway Lighting

DURING 1936 more miles of highway were illuminated than during the preceding five years. The tempo of research work on this important phase of highway safety was stepped up and there continues to be a great interest shown in the future of highway illumination.

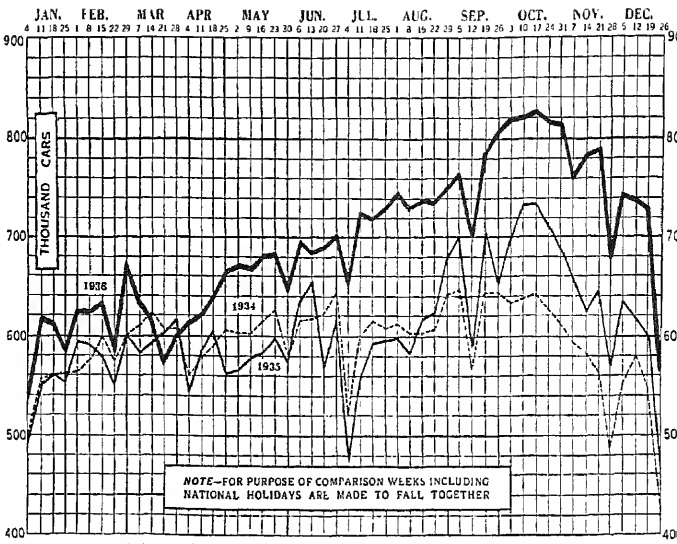
The longest sodium highway-lighting installation in the world is on a section of the New York State Route 7, known as the




A power-plant in a package—Steamotive

Duanesburg Road. It utilizes 390 10,000-lumen sodium highway-lighting units for illuminating 17½ miles of highway.

The world's longest bridge, the San Francisco-Oakland Bay Bridge, is appropriately lighted with the golden light of more than a thousand 10,000-lumen sodium luminaires.



Freight car loadings, barometer of business, continue to improve

### DIESELS

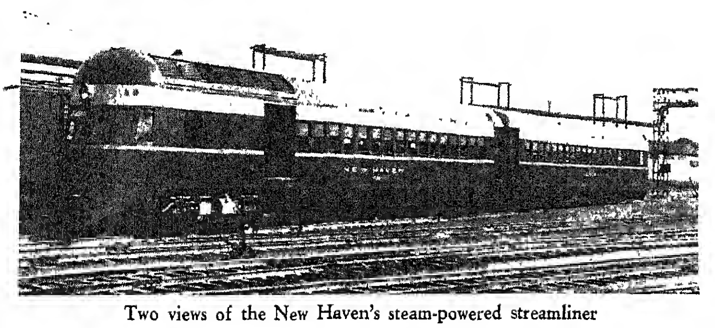
**A NEW annual production record for Diesel-electric locomotives was reported in 1936. During the year 50 such locomotives were placed in service or were under construction.**

## Steam-Powered, Streamlined

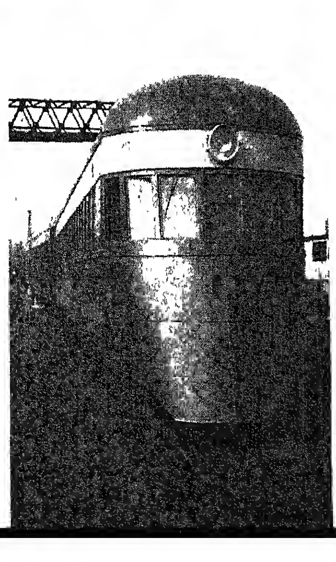
FOR several months the New Haven Railroad has operated a new streamlined, steam-powered, two-car train between Bridgeport and Hartford along the Naugatuck Valley. The train consists of two cars with an over-all length of 163 feet, and seats 152 passengers. Both ends of the train have been streamlined, and while the entire power unit is located in one end of the train, controls are located in each end, allowing it to be moved in either direction without time-consuming and expensive turn-around movements. The sides of the coaches reach almost to the ground, presenting a smooth and uninterrupted surface.

Air-conditioning equipment is an auxiliary unit of the train capable of producing the equivalent of fourteen tons of ice per day. Adequate heating is supplied in cold weather by means of shielded thin tubes which take up very little space but give rapid radiation.

The power plant of this train is unusual in that it is steam-operated and occupies a space only as wide as the car and seven feet long. It consists of three main units—the boiler with its auxiliaries; the condensers with their fans; and the power truck. The total power plant weighs only 8500 pounds. The boiler is heated by an oil-burning device somewhat similar to that in use in home furnaces and is fully automatic. When the steam pressure drops, the boiler



Two views of the New Haven's steam-powered streamliner



automatically starts and stops when the desired pressure has been reached. While the unit is of the high-pressure type, it is entirely safe and has passed all of the tests applied by the Interstate Commerce Commission. After steam has been generated in the boiler to approximately 1200 pounds, it is taken to the power truck, which consists of two high-pressure and two low-pressure cylinders located directly on the truck. The steam first enters the high-pressure cylinders and then passes to the low-pressure cylinders, thus doing double duty before it is returned to the condensers located on the top of the train, where it is condensed into water ready to start the cycle from water to steam and steam to water again.

Safety features on the train are many, including a train signal device which reproduces in the cab the signals along the track. The throttle is also automatic in that if the pressure of the operator's hand is released the train immediately stops

## Biggest Welded Ship

THE new tanker to be built for The Atlantic Refining Company in the Chester shipyard of the Sun Shipbuilding Company, will be the world's largest welded ship. With a dead weight tonnage of 18,500 tons, the new oil carrier will also be the largest commercial vessel under construction in American shipyards.

The new tanker will have a length of 521 feet between perpendiculars, a beam of 70 feet and a cargo capacity of 156,000 bulk barrels of gasoline. Turbo-electric engines, developing 5000 horsepower, will give the vessel a speed of over 13 knots, enabling it to make the trip between Philadelphia and Texas gulf ports in the unusually fast time of six days. It will carry a crew of 8 officers and 26 men.

Preliminary construction work has already been started and the vessel is scheduled for delivery to the refining company by the end of the year.

## Pipe Lines No Pipe Dream

PAUSE a moment and think of the different commercial transportation systems in modern America; the railroads, motor vehicles, airplanes, lake and river transport, and the electric trolley lines. Is that all?

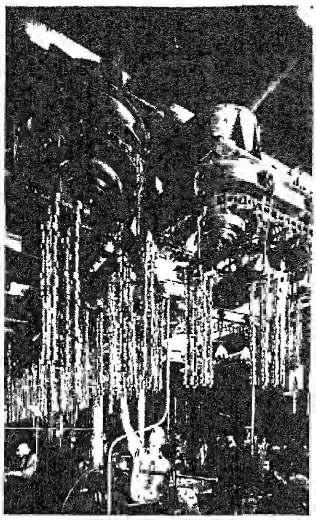
No! Another one is the pipe-line.

People who think of pipe-lines as a form of transportation are distinctly in the minority and of these few only a tiny fraction realize that they are the second ranking form of commercial transport following right on the heels of the railroads in the total loads carried, as expressed in ton-miles.

Ranked in North America on the ton-mile category, the transportation systems are tabulated by *Science Service* like this:

| | | |
|---|---|---|
| Railroads | 500,000 | million |
| Pipe-lines | 400,000 | " |
| Motor Vehicles | 34,000 | " |
| Electric R. R. | 11,000 | " |
| Inland Waterways | 11,000 | " |
| Airplanes | 33 | " |

Pipe-lines by their very nature seldom come into the consciousness of the average citizen. You turn on the water faucet in the



Icicles in a factory? Not at all; the unusual pattern effect is created by Ford V-8 crankshafts hanging from chain conveyors as they move toward the motor assembly lines

kitchen without realizing that back of that flow of water are miles of water pipes; 211,000 miles of them, in fact, on the North American continent. And behind the gas stove in the kitchen are a collective 312,000 miles of pipe in Canada, the United States, and Mexico.

Moreover, there are 425,000 miles of sewerage pipe-line system and 100,000 miles in petroleum transmission lines. Natural gas transmission lines add a final 65,000 miles of pipe to the total.

Transmission of fluids is one of the oldest technical arts, points out the *Bulletin of the Ontario Research Foundation.* Pipes and aqueducts were, of course, common to the old Romans. But even earlier the Chinese piped natural gas through bamboo poles laid with large ones and small ones alternating so that their ends fitted into one another. The joints were sealed with wax.

*(End of Transportation Section)*

## Colonel Lindbergh's Latest Plane

It is rather sad to think that Colonel Lindbergh now lives in England, and that his latest airplane, the Miles Mohawk, was built by a British firm, Phillips and Powis. But of course it serves us right! In the design of his new craft, the famous pilot supervised every stage of the engineering, and the result is a machine in which the efficiency and convenience of the pilot have been studied in every detail—even to the external color scheme, which is orange and black because these colors show up boldly in all conditions of weather, in blinding sun or in mist.

It makes us feel a little better to know that at least the power plant is of American make. The engine is a supercharged, 200-horsepower Menasco, an in-line, air-cooled engine, with its cylinders inverted so that the pilot's vision is not hindered in the least.

The external lines of the Miles Mohawk are not of conspicuous novelty, though they are clean and neat. The landing gear is streamlined to the limit, but is *not* retractable. At least when Colonel Lindbergh and his wife adventure afar they will never be bothered by a landing gear refusing to come down or go up. The low, cantilever wing is familiar and so is the split flap, widely employed by designers in the United States. The top speed of 200 miles per hour is up to the very best standards, particularly with a gross weight of 2700 pounds, a figure which is fully justified when the equipment carried is taken into account.

But the greatest interest lies in the arrangement of the cockpit and equipment.

The two seats are located in tandem, on the front and rear spars respectively, and are covered in by an exceptionally neat transparent roof; transparent side panels can be slid up and down at will. The enclosure has concave sides, permitting the pilot to look outside without exposing more than a fraction of his face. Behind the rear seat is a roomy luggage compartment with a recess for suitcases which is accessible from the cockpit as well as through an external door. Further aft is stowage for a tent, a collapsible dinghy, and other articles likely to be useful on long journeys to out-of-the-way regions. Radio, flying, and navigation equipment is equally complete, and seaplane floats may be readily substituted for land wheels.

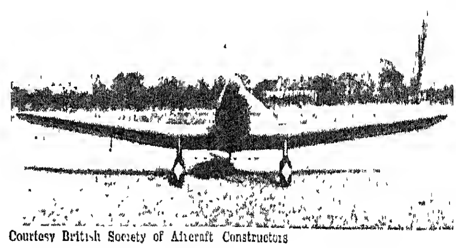
May the Colonel and Anne Morrow make many interesting flights and give us another fascinating book.—*A. K.*

## The Menasco Buccaneer

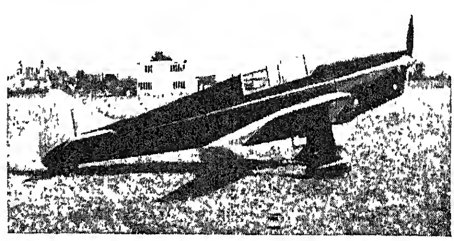
If our readers will examine the photograph of the Menasco six-cylinder "Buccaneer" engine, they will see how this inverted engine fits into the narrow nose of Lindbergh's new plane and gives the unimpeded vision ahead which a pilot so much desires.

The public sees nothing but radial air-cooled engines on the large transports. We can assure our readers, however, that in-line air-cooled engines for aircraft of moder-

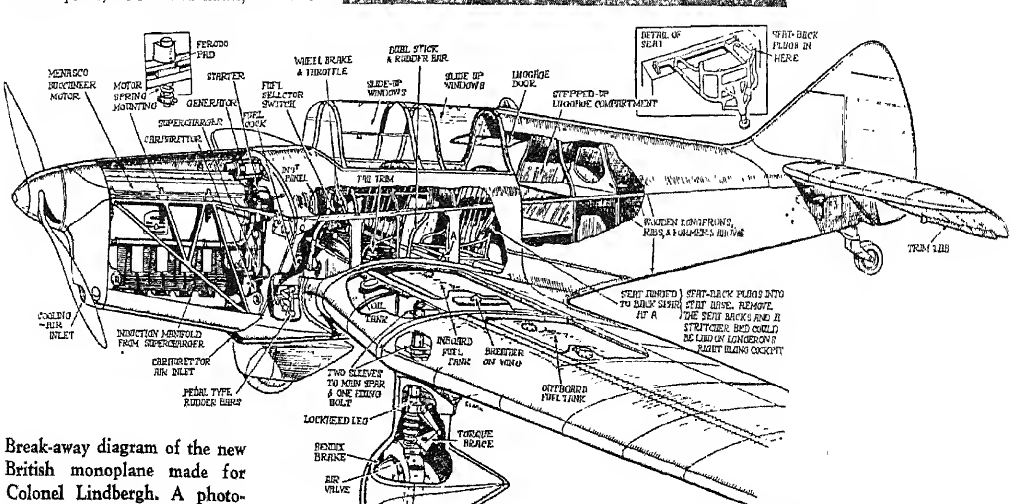
*Right:* Front of the Miles Mohawk plane built for Colonel Lindbergh. The highly streamlined landing gear is not retractable



Courtesy British Society of Aircraft Constructors



*Left:* Side view of Colonel Lindbergh's new plane, showing the neatly enclosed cockpit with transparent roof and concave sides, giving good visibility

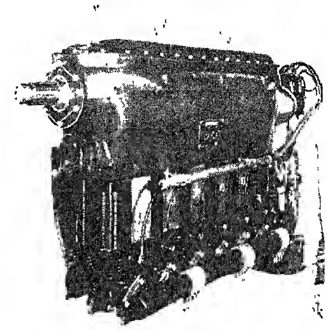


Break-away diagram of the new British monoplane made for Colonel Lindbergh. A photograph of the motor appears on page 180. See description above

Courtesy *The Aeroplane*

ate power are worthy of serious consideration. The Buccaneer, after six years of development work by the Menasco company, develops 200 horsepower at 4500 feet altitude, thanks to its moderate supercharging, and has made a splendid record for itself both in private flying and in aircraft racing.

Besides the unimpeded vision, the following advantages are claimed for the inverted



Inverted Menasco Buccaneer

in-line type: low frontal area which is a help in streamlining; noise and exhaust carried away below the cockpit; high propeller thrust line; high degree of accessibility. These engines are as well designed and constructed in every detail as their more powerful brethren of the radial type, and have as many and as efficient accessories.

The Buccaneer weighs 415 pounds. As compared with the radials, this is heavy. But as compared with the six-cylinder automobile engines which people are endeavouring to use in aircraft, and which weigh close to 500 pounds while developing only a little over 80 horsepower, they are very light.—*A. K.*

## A Pilot's Most Dangerous Time

IN a recent address before the National Association of State Aviation Officials, James E. Hoskins of the Actuarial Society of America gave some interesting information on the most hazardous stages in a pilot's career.

It appears that the most dangerous time in a pilot's career is not while he is taking instruction in the early part of his solo flying, but during a certain period after he has received an advanced license or a military rating. "At first he knows he is green and plays safe; eventually he gains skill, but there is an intermediate time when his self-confidence exceeds his ability," said Mr. Hoskins.

Pilots who have been involved in an accident, or who have been disciplined for violation of air regulations, have a greater chance of a fatal crash than those who have not. They might be expected to be more careful. Perhaps the pilot who has had an accident or who has been disciplined show a lack of physical or mental aptitude?

According to Mr. Hoskins, no great difference has been observed between the safety records of younger pilots and those of more mature years. This is contrary to widely accepted opinion.

What type of flying is the safest? Mr. Hoskins is quite sure that the flying which is most closely supervised, either by govern-

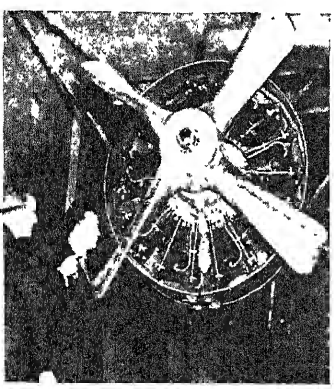
ment inspectors, by responsible airline operators, or by corporations owning planes for their own use, is far safer than private flying undertaken for pleasure. This will not encourage us to accept a friend's invitation to "come and fly with me some time." —*A. K.*

### Motors Tested in Sound-Proof Cell

AN automobile engine, unmuffled, makes quite a little noise. But it is merely whispering as compared with the overpowering roar of the Wright Cyclone G developing some 1220 horsepower at 2200 revolutions per minute. The Wright Aeronautical Corporation's engineers have the arduous task of testing such engines on a 24-hour a day schedule. Now while the town of Paterson, New Jersey, is extremely proud of its mighty aircraft engine factory, and owes no little of its welfare to the large orders received by Wright's, its citizens did suffer from the noise, and did not scruple to make violent and continuous complaints.

So the aircraft motor engineers turned into "acousticians" and built completely sound-proof test cells as part of their new testing equipment.

The sound proofing was based on a combination of three principles. In the first place the walls of the cells were made of a porous substance which absorbs much of the sound. Secondly, the exhaust vent into the open air consists of a deep honeycomb which breaks up the sound waves before they emerge into the atmosphere. Lastly,



Airplane motor ready for test

the suspension of the engine itself is an important factor. The engine under test is mounted on the end of a large steel cylinder about 10 feet long, which is suspended 10 feet above the floor in a three point cradle of cable loops anchored to the walls and the floor. Vibration at the anchorage points of the cables is absorbed by rubber washers which separate the bearing surfaces from the structure of the building. These methods have proved entirely efficacious and the complaints of Paterson inhabitants have ceased.—*A. K.*

### Feeding Birds From the Air

THE peacetime applications of flying never cease to increase in scope and number, as a good offset to the dangerous functions of the airplane in war. Thus we hear that Commissioner Harry M. Armstrong of the New Jersey Fish and Game Commission has saved the lives of thousands

and New York, by spreading grain from the sky, at a time when ice prevented approach to the starving birds by any other means. The procedure was simple. A plane loaded with 500 pounds of grain, packed in one-pound bags, flew over the desolate area. Thumb holes were punched in the paper bags just before they were tossed over-board, and the grain from each bag scattered over a 25-foot circle on hitting the ground.—*A. K.*

## Have Aviation Shows Any Utility?

At a recent luncheon gathering of well informed aviation men we heard the question of the utility of aviation shows discussed rather heatedly. It is a terrible bore to manufacturers' representatives to answer questions all day, mainly from small boys who walk away with great quantities of expensive pamphlets, photographs, and so on. At an automobile show cars are sold right there and then, on the floor of the show. But very few people buy an airplane without having had a demonstration flight, so that measured in dollars and cents the results of an aircraft show are apt to be disappointing. But aviation shows serve to educate the public in a way which no other activity does, and their indirect results are valuable to industry and public alike.—*A. K.*

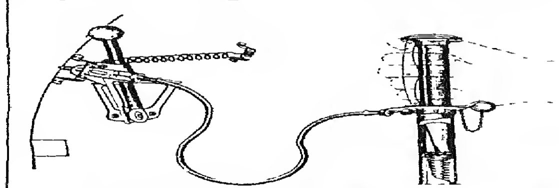
## Model Airplane Flies Four Miles

It is interesting to note that Lieutenant Hewgley and Sergeant Lewellyn of the Army's 12th Air Base Squadron have flown a gasoline-powered model airplane a distance of four miles—the world's record. Flying a powered model is a most interesting sport, and the builders of these craft have acquired uncanny skill, so that the powered models take off, maneuver, and land almost as if they were manually controlled.—*A. K.*

## Safety Device for High Altitude Flying

In a recent issue we described the British airplane which holds the world's altitude record. The French have also given much care to the equipment of high altitude machines, and in the Potez 50 a safety device is provided which is not available in the aircraft of other countries.

This is an attachment to the control column, which is a safeguard against loss of consciousness by the pilot should his oxygen supply fail him or some other mishap occur at high altitude. It is illustrated



If an airplane pilot becomes unconscious, the throttle will automatically close when his grip relaxes

in the sketch, which we owe to the courtesy of *Aircraft Engineering*. A grip lever is mounted on the control column and is normally held against the column by the pilot's hand. If the pilot relaxes his grip the handle is pulled down by a spring, which at the same time actuates a Bowden cable. The cable disengages a peg or locking pin and the throttle lever is moved back by the closing spring, so that the gas supply is shut off. Further, the plane itself is so rigged as to be slightly nose heavy. When the pilot no longer holds the control column, the ship noses down into a glide to earth.

The supposition is that the pilot recovers consciousness long before he approaches the ground, and has plenty of time to resume control before landing.—*A. K.*

## The Next Five Years in Aviation

THREE great engineering societies recently combined their efforts in organizing a symposium entitled "The Next Five Years in Aviation." The American Society of Mechanical Engineers, the Institute of Aeronautical Sciences, and the Society of Automobile Engineers are to be complimented on the results of this meeting, which produced not a purely imaginative effort of the H. G. Wells type, but a serious technical projection of the advances of the next few years.

All important air-cooled engines will develop well over 1000 horsepower in the near future. The specific weight will be less than one pound per horsepower. The fuel consumption of the gasoline aircraft engine will, in the next five years, be reduced to 0.35 pounds per horsepower-hour as compared with the 0.5 pounds of to-day. This great advance in economy will be due, to a large extent, to the introduction of improved fuels, of a very high octane rating, which will allow compression ratios to be increased even further than to-day.

At this meeting the aircraft Diesel apparently did not have a single friend. If the above economies are attainable with gasoline, we can readily see that the aircraft Diesel will have harder sledding—fire prevention will be the main argument of the Diesel proponents.

Our readers have often written in to ask why the Junkers Diesel is so generally used and so highly regarded in Germany, and why it did not get a footing in the United States. A well informed and distinguished German aviation constructor gave an explanation during the meeting. The only reason the Germans are using the Diesels in their transport planes is because the gasoline fuel situation is so difficult. If Germany had an unlimited supply of gasoline, they would themselves abandon the use of Diesels for airplane work!

Igor Sikorsky spoke with his usual vigor and authority about aircraft weighing 100,000 to 200,000 pounds which will be under construction in the next five years. Cruising speeds will be increased to 200 miles an hour for flying boats, and 250 miles an hour for land planes.

The writer of these notes had the privilege of making predictions from the same platform. He really made no predictions but raised what Mr. Sikorsky thought to be an interesting point. As planes increase in the giant ocean liners which need a small army of tug boats to bring them into dock. Now if airplanes get bigger and better, and consequently less maneuverable, how will they ever bring themselves into the landing glide, and how will they ever flatten out again? Will they have to be provided with airports fifty miles in length, perchance? There are methods, as a matter of fact, of maintaining maneuverability while increasing size, but real difficulties remain to be solved.

The Sperry Gyro Pilot is now universally employed on the airlines. When the Gyro Pilot has conquered the transport field, will it be reduced from its present cost of several thousand dollars to a price of, say, ten dollars so as to be available for every private airplane? At present the use of the Gyro Pilot on a small private plane would be absolutely prohibitive from the point of view of expense and of the care required in maintenance. But the electric starter for automobiles was once also regarded as a tremendous luxury—now no car would sell minus an electric starter.

Space will not permit us to give the views of other distinguished speakers. It is to be hoped that these learned societies will in time make the full views of these engineers available in detailed reports.—*A. K.*

## Determinism and Man

SCIENTIFIC writers who have turned to the philosophical interpretation of science are invariably concerned with the re- biological science he creates. These writers fall, roughly speaking, into three schools.

The first maintains that the methods that man has evolved for the study of the physical universe can be applied, without fundamental modification, to the study of mankind, and of man as an individual; that the determinism of physical science must apply equally to characteristics of the individual, and that from this can be deduced the behaviour of the mass. The universe, including man, is a complex machine. These are *mechanists*.

The second school sets man and his mind apart from the rest of the universe, asserts that although he is amenable to physical laws, these do not determine the whole of his actions, and that otherwise he is "free" to act as he wills, in accordance with or against his moral conscience. There is a great variety of such *philosophical idealists*, ranging from the solipsist who maintains that the universe is created out of the elements of his (the particular solipsist's) consciousness, to those who believe that man, in the exercise of his will, is working out the law of a Superior Intelligence that exists outside man.

The third class asserts that man is a product of material nature, consciousness being a complex quality of the brain; that physical science has been produced by man in his struggle with the material world; that the scientific laws he finds operative to inanimate matter are not necessarily valid as they stand for the more complex problem arising when man, the active agent, is in-

(Please turn to page 196)

# THE AMATEUR TELESCOPE MAKER

**Conducted by ALBERT G. INGALLS**

HOW heavy a hold the telescope making hobby has taken on people is indicated by frequent reminders. We learn that courses in telescope making are now being given at New York University, also at the Pennsylvania State College, and we go so far as to predict that graduation credit for this work will eventually be given at many universities, presumably in the departments of physics. Writing from Eindhoven, Holland, T. L. Rinia advises us that "telescope making is now rapidly becoming popular in Holland."

Amateur telescope makers in any community will testify to the interest their telescopes have aroused locally, some of the owners deciding they have become too popular by half, since the townspeople had learned where to get a free peep at the moon at all hours. One man threatens to "leave town or else commit suicide," in order to escape this kind of popularity, but others have enjoyed the nightly visitors. J. Milo Webster of Wyomissing, Pa., has kept a visitor's book at his observatory (see pictures in "A.T.M.," pages 455, 456) and says the book was entirely filled up, last summer, with 4000 visitors' names! In Rochester, N. Y.—the optical city—they had a hobby show, with stamp collectors, painters, cactus growers, micro-biologists, engine model builders, fancy quilt makers, and telescope makers among those represented. The Rochester Astronomical Society, with a membership of 100, won the silver cup as First Prize. In that city, too, the university is apparently in contact with the telescope making hobby, as the Rochester Astronomical Society has the co-operation of the university Department of Optics.

New astronomical and telescope making societies seem to spring up daily. Photographs of two of the older clubs are shown in Figure 1. In half-tone reproduction the reader can't clearly make out features, but we have been all over the original photographs with a 2" lens and, as we used to say in the army, each club group is a "fine body of men."

WHEN we first published "Amateur Telescope Making," 11 years ago, we had no idea the hobby would take such a determined hold on our readers, but today, in addition to that book, now in its fourth edition and "going strong," we now have the new book "Amateur Telescope Making—Advanced," the sequel to "A.T.M." and 150 pages larger. This most recent book harks way back to a thought we had while lying abed about 11·23 A.M. one Sunday morning in 1925, even before the thin first edition of "A.T.M." was conceived—namely, to bring together, *in one place*—that is, between the same two covers—reprints of some of the things we had already been chasing up in different public libraries, at considerable inconvenience. Other items in "A.T.M.A." have been written by amateurs who took up the hobby as beginners soon after "A.T.M." first appeared. Together they show how the amateur, starting at scratch and in ignorance, has performed the feat of virtually lifting himself aloft by his own bootstraps—a process of levitation which still continues, for standards improve every year.

In dividing "A.T.M.A." into two parts, one on practical "optics" making, the second on the "more practical aspects of observing," we have had in the background of our mind the possibility that, some day, if the hobby continues marching on as it has, each of these parts could be enlarged and built into a separate book. Readers' reactions to that thought are solicited. Would there be enough market for the second book (on observing) to make it economical?—say, a sale of 3000 copies—for these books must pay their way in the world.

However, avast with thoughts of making new books for the present: what we now want most, after just a year of spare time work at home, in preparing "A.T.M.A." (all this hobby work being done on time sneaked in between regular work on the magazine) is to do a long stretch in an overstuffed chair, with time to yawn frequently. Ho, ho, hum—haven't been to the movies in a year and Mae West is on tonight. By the way, please turn in proof errors, found in reading "A.T.M.A." We save these with care, against a later edition.

In case you prefer the drawing in Figure 2, to the one on page 521 of "A.T.M.A.," you may cut it out and substitute it. When invited to make the drawing for that humorous page to provide a break between Part I and Part II, R. W. Porter sent us two drawings—perhaps we selected the wrong one. Every amateur should learn this song, a parody on the Gilbert and Sullivan light opera "Pinafore," with its catchy music.

Speaking of songs reminds us of poetry. The Enid Crawford Pierce who wrote the verses about dinosaurs, on page 196, is Mrs. John M. Pierce of Springfield, Vermont. Some think the philosophy is a bit gloomy but the verses reached us one day when we felt just that way. So we accepted them. We are born, we grow up, worry about income taxes, make telescopes, make other telescopes, and die. "What's the use—only an egg yesterday and a feather duster tomorrow." But tomorrow, unless it rains again, we may feel different.

HERE is an interesting note by R. W. Porter. See Figure 3: "If a template, used either as a grinding or polishing tool, is moved across a spherical concave disk, it will *automatically* produce a paraboloidal surface of revolution. The tool (template) moves parallel to itself from about *A* to *B*, the disk slowly revolving beneath it."

CONSIDERABLE interest has been shown in small items regarding the theory of polish, published here from time to time, the question being whether polishing is sub-microscopic scratching or some kind of molecular flow. The following is from a recent article by Dr. Wilbur B. Rayton of the Bausch and Lomb Optical Co., in *The Review of Scientific Instruments*, Vol. 7, No. 9.

"In the process of grinding, the particles of emery plough out channels by 'springing' out a series of small chips. Apparently the emery particle serves as a point of compression building up pressure until the glass is locally strained beyond the elastic limit, whereupon a chip flies out and immediately the process begins again at a point a little farther along. The chips are removed by a process quite similar to the process by which flakes of flint are sprung out of the surface in the fashioning of arrow heads.

"The polishing process is not so well understood. The ground surface consists of minute hills and valleys. Does the polishing process remove material from the hills until all of them are reduced to the level of the bottom of the valleys or does the material removed from the hills partially fill up the valleys?

"For a long time it was known that pol-

*Figure 1: Amateur Telescope Makers of San Francisco and, right, Indianapolis Amateur Astronomical Associa...*

*Figure 2:* The unforgettable, catchy song of the amateur astronomer

ished surfaces on calcite crystals used in X-ray spectrometers were much less satisfactory than natural fracture surfaces. Professor Richtmyer eventually discovered that if after a calcite surface was ground, but not polished or only lightly polished, it was etched with weak acid its behavior became equal to a natural fracture surface and, in speculating on the cause of this effect, suggested that it might be explained by assuming that the grinding process left embedded in the surface great numbers of small crystals which, although broken away from the original crystal, were lodged in pits on the surface but with their crystal axes running in all directions. Such loose crystals would be subject to attack on all sides by the acid and would therefore be dissolved, leaving a surface which might be rough but which would be completely regular insofar as crystal axis was concerned and that it would reflect X rays as a single crystal. Apparently polishing the calcite serves to make the surface appear to be continuous, the outstanding characteristic of a polished surface, but does not remove the debris left in the pits in the process of grinding. Whether there is any reason to extend this reasoning to the grinding and polishing of glass is not immediately apparent. Glass is amorphous and calcite is a crystal but in spite of this there is the thought that a polished surface on a piece of glass may be a sort of a false front that makes an actually

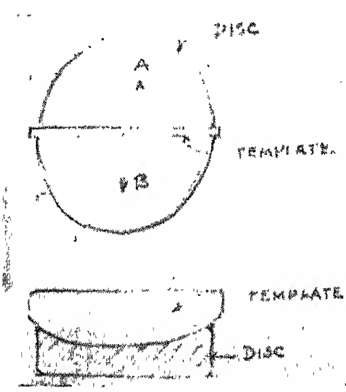



*Figure 3:* Professor, please tell

chaotic condition present the appearance of order."

WE have been looking over an accumulation of unpublished descriptions of telescopes, with photographs, and out of about 100 only nine could be found which haven't a slender "bottleneck" ("A.T.M.," fourth edition, page 130) between the tube and declination axis bearings. It seems almost hopeless to harp on that point—folks evidently *will* build 'em wobbly. Here on these pages are four other descriptions we ran across, with interesting features. Figure 4 shows not only a swiveling eyepiece for a Cassegrainian, but a finder which swivels around with it, remaining always parallel to the optical axis. Thus the user can choose a comfortable position for both eyepieces. G. L. Ardery, 205½ West Third St., Yankton, S. Dakota, made the telescope.

Figure 5 shows one of the inverted engine block polar axes described in "A.T.M.," fourth edition, page 142. B. L. Bradley, 235 North High St., Salem, Oregon, is the maker. He also writes: "Here is a suggestion for those who may have trouble in

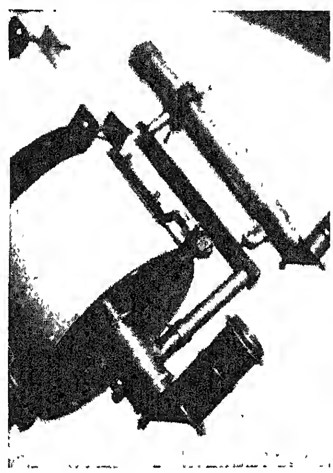


*Figure 4:* Ardery's conception

squaring the mechanical parts of their telescope. (I had lots for a while.) I finally ran across the idea of using my 5" scope with cross-hairs to square up the mechanical parts of the 8" telescope. I carefully marked the center point of the dec. axle, both ends. Then I lined up on the center point with my 5" portable scope, putting the center point of the axle just on the cross-hair. It takes two people to do this, else you may walk the equivalent of several hundred holes of golf before the center points coincide. Continue to revolve the dec. axle around the polar axle, and adjust the set screws in the T-pipe fitting until the center points coincide on the cross-hairs. I used a similar procedure on the tube with reference to the dec. axle."

Figure 6 is a sea-going telescope. H. Leroy Benfer of the Radio Department, *S.S. Santa Clara*, left it with us. (Incidentally, we think no more graceful steamers sail the seven seas than the *Santa Clara* and others of the Grace Line's Santa class. They go through the Panama Canal and down the west coast of South America, also to California. Beautiful lines, these new vessels have, and we make our bow to the naval architect who laid them down.) Mr. Benfer says he gets quite a little use of his telescope—though not often on the high seas.

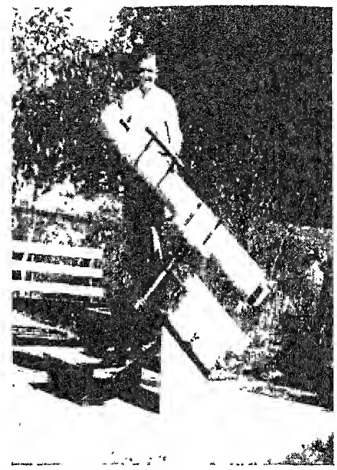


*Figure 5:* Bradley's ex-Lizzie

A photo of the moon he sent shows good sharp resolution of detail. Many other photographs of the moon have been sent to us, but when reproduced in half-tone they would all look exactly alike; the half-tone would knock out any excellence they might possess. This is why they are not published.

After the sea-going telescope comes a land-going one, with pedestal permanently bolted to the rear of a car (Figure 7). C. C. Miller, president of the Amateur Telescope Makers of Kansas City, concocted this mounting. He says the tube is detachable and is taken inside except when in actual use. A trout rod and line show dimly, leaning against the mounting.

AT present several are either making 20" Pyrex mirrors or flirting with the idea. How about getting up a "Twenty-Inch Club" among these aspirants? Doubtless they could help one another to a considerable extent, a 20" being quite a job to tackle all alone. Let's hear from all of them.

HERE is a note from T. E. Morgan, of the *Sacramento Shopping News*, 2836 Fifth Avenue, Sacramento, Calif.: "Those amateur telescope makers who have had their mirrors silvered by just anyone should inquire about the methods to be employed before entrusting them to some workman

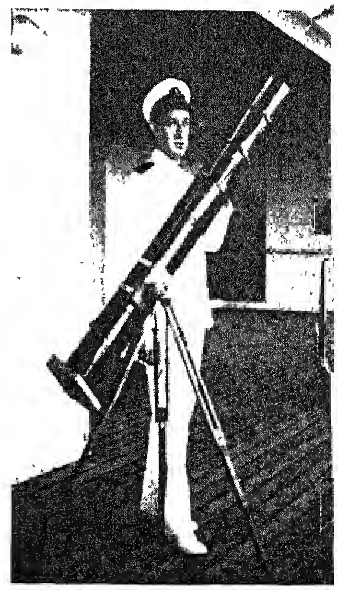


*Figure 6:* Benfer's amphibian

ignorant of an optical surface. Not having the slightest idea of an optical surface, much less matters of a few millionths of an inch, they do it about as follows: Using no chemicals to clean the mirror, they smear rouge—probably poor rouge at best—on a cotton pad and rub the mirror in all manner of strokes and probably in spots. If they think it needs more polishing they may even use a motor driven buffer. 'Oh well,' they think, 'it's just another mirror and we'll put a film on it with no spots, and polish it well.' The remainder of the method is to use the silver with heat and more rubbing of the rouge pad. It nearly happened to me."

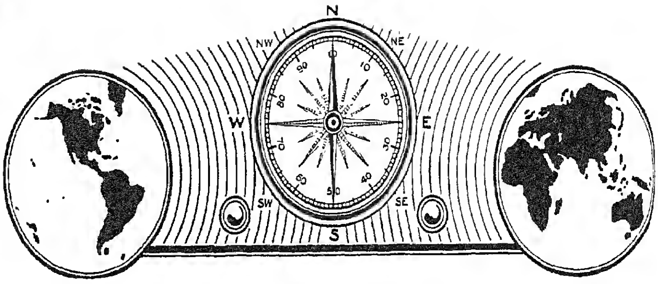
DURING the World War there was a dearth of practical optical workers, and persons who had even elementary knowledge of optical work were at a premium. In case this nation got into war again (and let's hope it won't) it would turn to the thousands of amateur telescope makers for help. Not, however, that every man who can tell rouge from pitch will be made a field marshal. Just a thought.

ABOUT the slip ring idea ("A.T.M.," p. 146): Frequently amateurs invent this independently. Actually it is very old. "I don't know how old the idea is," is what Prof. H. D. Curtis, mechanically-minded astronomer and designer tells us when asked, "but I feel pretty sure that Saegmuller used it on his mountings way back before 1900. In the 'Handbuch der Astronomische Instrumentkinde' the earliest mention seems to be in mountings made by Fritsch about 1893."

IT is regrettably necessary to end on a very sad note. New York papers of January first contained the following bare item: "Kildarton, Armagh, Ireland, Dec. 31 (U.P.)—Canon W. F. A. Ellison, rector astronomer of the Armagh Observatory since 1908, died today."

This is the total of our present knowledge of the matter, though we hope soon to learn more. Rev. Ellison was about 72 years of age, and a year or two ago was made a canon of the Church of Ireland. Thousands of American amateur telescope makers will add their regrets to those of Ellison's pupils elsewhere in the world at the loss of this great preceptor who has given so much enjoyment and satisfaction to all of us.

*Figure 7:* Miller's motorscope




# WORLD-WIDE RADIO

**Conducted by M. L. MUHLEMAN**
Editor, *All-Wave Radio*

## German Regional Broadcasts

THE German short-wave station, with studios in Berlin, began a special series of regional broadcasts directed each month to a different part of the United States or Canada. These broadcasts pay special attention to local interests and tastes. Berlin started with this type of transmission in October by directing a special broadcast to Texas on the occasion of the centenary of the Lone Star State. This was followed in January by a broadcast addressed to New Yorkers, and in February to the Pacific Coast. The March broadcast will be for the benefit of New Englanders.

## New Hong Kong Station

A NEW short-wave broadcast transmitter has been installed and is now operating in Hong Kong, China. The power of this station is 2.5 kilowatts and replaces a small experimental transmitter of only 0.5 kilowatt.

Four frequencies have been assigned to the new transmitter. The selection of these will be governed by seasonal conditions, and the particular frequency in use will be indicated by the call, as follows:

| Call | KC | Meters |
|---|---|---|
| ZBW2 | 6090 | 49.26 |
| ZBW3 | 9525 | 31.49 |
| ZBW4 | 15190 | 19.75 |
| ZBW5 | 17755 | 16.90 |

Both European and Chinese programs are broadcast and the transmissions commence daily at 11:30 P.M. Eastern Standard Time, except Saturday, when the time is 9 P.M.

## Unusual Broadcasts

BRITISH listeners were thrilled when some time ago they heard a message of cheer broadcast to the 30 men and women of a film unit who were "storm-stayed" on the Island of Foula in the Shetlands. The message was: "If the marooned party is listening to the broadcast, we take this opportunity of sending them a word of greeting along with the hope that the sea will soon subside."

Messages of this character are not often broadcast. In the early days of the Spanish conflict an appeal was broadcast to British nationals in Spain, urging them to take advantage of the facilities offered for leaving the country. In a less serious vein was the appeal to the patrons of a great sporting event in the north of England who had hired cushions and gone home with them. About 4000 cushions were missing and in response to the broadcast message about 600 were returned. Another message which caused some amusement was sent by Sir Harry Lauder at the end of one of his programs. He informed his wife of the time of his departure from London, and of his arrival in Dunoon. As he said: "That will save me the price of a wire, ye ken."

## Fiji Changes Wavelength

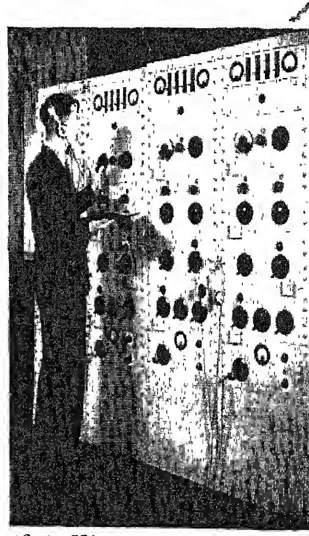
THE wavelength of short-wave station VP2, at Suva, Fiji, has been changed from 22.94 meters to 31.45 meters. This station broadcasts daily, except Sundays, from 5:30 to 7 A.M., Eastern Standard Time.

The Suva station, although it has been operating for only a year, already has a large audience. It is heard clearly in this country, and quite recently one of its programs was rebroadcast over the NBC network.

## BBC Checking Station

THE frequency-measuring equipment employed by the British Broadcasting Corporation at their receiving and checking station at Tatsfield is correct to one tenth of a cycle if a megacycle is the frequency to be measured; in other words, it is correct to a ten-millionth part.

Hundreds of measurements are made daily, and if any station is not keeping to



Courtesy BBC
**The four short-wave relaying receivers used at the BBC receiving and checking station at Tatsfield**

its frequency, representations can be made founded on practically absolute accuracy. In addition to checking long, medium, and short-wave stations, Tatsfield is also the receiving station of the BBC through which programs are relayed from overseas, passed through to Broadcasting House in London, and then distributed as required. A view of the Receiving Room is shown in the accompanying photo.

Tatsfield is the third receiving and checking station of the BBC. Previously similar stations were installed at Keston and Biggin Hill. Each of these stations was erected in pleasant pastoral country in Kent.

## Ears for Propaganda

THERE are now about 6,700,000 radio receiving sets in the United States capable of picking up European and other overseas programs, according to Bond Geddes, executive vice-president of the Radio Manufacturers Association in Washington.

This means that about one fourth of the radio families in the country, the number of which is estimated to be 24,269,000, are now able to listen to foreign as well as domestic radio programs.

## Guide to Short-Wave Reception

TO simplify the somewhat different operations of the short-wave feature of the modern all-wave radio receiver, as well as to explain in popular language just how the short waves differ from the more familiar broadcast wavelengths, the Electrical Division, Bureau of Foreign and Domestic Commerce, has made available a fifteen-page booklet titled "A Guide to Reception of Short-Wave Broadcasting Stations." The material was prepared by Lawrence C. F. Horle, a prominent radio engineer, working in co-operation with the Engineering Division of the Radio Manufacturers Association.

Since there are available throughout the country competent radio service experts, the booklet makes no attempt to instruct the listener in the intricacies of the servicing of receivers. And since the design and production of the modern all-wave receiver requires the highest type of scientific and engineering skill, no attempt is made to provide constructional details whatsoever except such suggestions as will assist the user in providing himself with a suitable receiving antenna for obtaining the best results with his set.

Sections of the booklet are devoted to installation of the set, to the characteristics of short waves, difference in time between countries, a list of the principal short-wave broadcasting stations of the world, a list of the international assignments of call letters, and instructions for tuning receivers. A time-zone map of the world and a chart of the world showing great-circle distances and azimuths from Washington, D. C., are also given, both by courtesy of the Navy Department's Hydrographic Office.

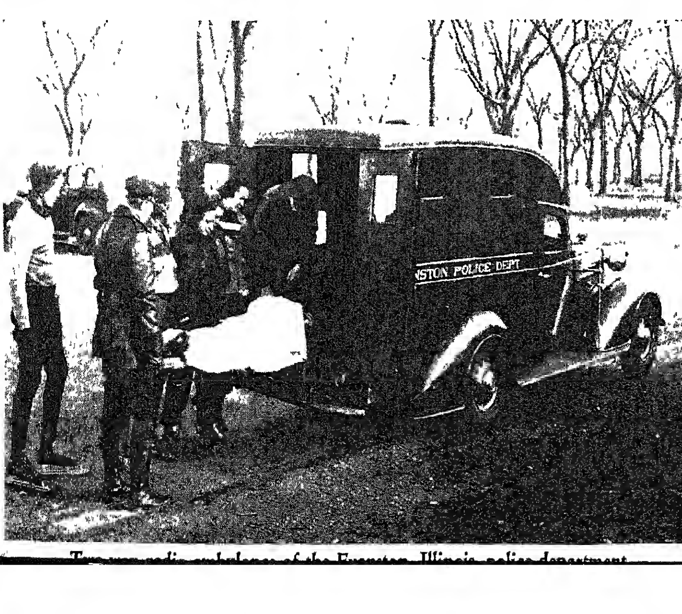
The booklet is now being sold through the offices of the Bureau of Foreign and Domestic Commerce in Washington at 25 cents a copy.

## Two-Way Radio in Ambulance

SNAPPED during a first-aid drill with their new two-way radio-equipped ambulance, police of Evanston, Illinois, are shown in the accompanying photo demonstrating how to deal with an accident at a skating pond. The ambulance, equipped with a transmitter as well as a receiver, constitutes one unit of an 11-car ultra-short-wave police radio system recently installed by General Electric engineers. It permits the police to carry on a duplex conversation with headquarters even while driving at high speeds.

This ability to maintain inter-communication at all times with the ambulance makes it possible to save valuable time in relaying word ahead to the hospital regarding needs of an accident victim. Among examples of vital messages that can be transmitted are requests that the operating room be made ready for immediate use on arrival and that special surgical or medical assistance be summoned—all of which is usually impossible to do, without two-way radio, until the ambulance reaches the hospital.

The transmitter in the ambulance has a power of 15 watts. The "buggy whip" visible beside the right front fender of the ambulance is in reality the radio antenna.



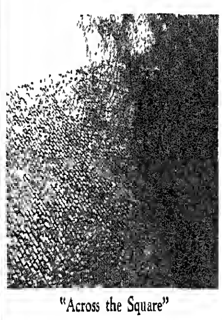
# CAMERA ANGLES

Conducted by JACOB DESCHIN

## Trailing the Shadow

THE term "shadowless" lighting was recently declared to be a misnomer. The view was held that no photograph is possible without shadow and every photograph owes its existence to shadow, even though that shadow be minimized down to the point where it just outlines the subject. Be that as it may, and putting aside the very reasonable assumption that those who use the term to describe so-called "high-key" lighting do not mean the term literally but do so merely from lack of a better name to identify this beautiful method, it is the thesis of the present article that a shadow is a lovely thing. And the longer it is, the better we like it.

By the use of a spotlight we can, of course, obtain very fine shadow effects indoors just as the "shadowless" workers get their results by liberally "flooding" the subject with thoroughly diffused lights, but many workers prefer to let the sun do the work. So they go outdoors in early morning or late afternoon, when Old Sol is low in the sky. This may appear to some like following the line of least resistance, turning away from the hard work of an indoor set-up under artificial light to a chance "set-up" provided by nature. But who is to say which is the harder, and who is to say which is the better? In the one case we imagine an idea and try to crystallize it into a picture; in the other we let nature do the work. But is this actually true? It takes imagination to perceive nature's set-ups, just as it takes imagination to work up an idea and to build it. Besides, if the result is an attractive photograph, affording pleasure to all who see it, who cares how it came to be made? We, for one, do not.



"Across the Square"

The four illustrations here shown will give some idea of the possibilities open to the camera shooter in search of shadow pictures outdoors. All were taken in the late afternoon at the Battery in New York City on a single occasion, which shows what a variety of material may be obtained in one locality in one visit if we will take some trouble in sizing up the situation, selecting the proper time of day, and being on the alert for any "come-and-go" pictures.

"At Ease"

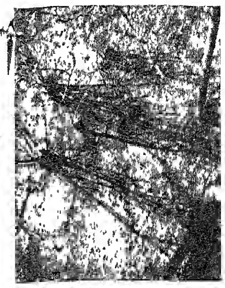
"Across the Square" was shot from the stairway leading to the elevated railway. (The patient readers of this department must by now be aware of our partiality for angle pictures.) The wide expanse of cobbled roadway leading to the piers seemed a perfect "canvas" for long shadows. As we waited for the right ones to appear, many shadows came and passed, each in its turn rejected until what you see came upon the scene to be quickly snapped and permanently recorded before it got away forever. It must be confessed, however, that we did miss one picture that might have been better than this one—a boy running across the square, his animated shadow enlivening the scene.

In Battery Park we came upon "At Ease" and were immediately attracted by the curve of park benches and the shadows they cast, with the "human interest" reading a newspaper at the farther end. It remained only for a pedestrian to come along and fill in the space at the left, which in a few minutes he obligingly did. The slight motion which you will notice in this walking figure is due to the 1/10th second exposure we were obliged to give because of the lateness of the day and the necessity of stopping the lens down for depth.

Climbing again to the platform of the "El" we were able to spot a few good subjects, two of which are "Late Afternoon Stroll" and "Winter Brush." The first was stopped down considerably in order to get both the foreground (the tree branches) and the strollers in sharp focus. We particularly direct your attention to the length of the shadows cast by the subjects, a little more than three and one-half times the height of the latter. Nor would we want you to overlook the pleasing pattern of the walk. "Winter Brush" is one of those things it is always a pleasure to photograph—texture. Maybe the subject isn't much to rave about, but just study that texture and just look at those shadows!

"Late Afternoon Stroll"





"Winter Brush"

## "Zeiss Photography"

IN these days of annuals and picture collections it was inevitable that the makers of Zeiss lenses and cameras should eventually put out a book containing outstanding examples of work done with Ikon cameras. It is announced that such a book, to contain more than 100 pictures, will be out during the current year under the name "Zeiss Photography." The sponsors promise that "no expense will be spared to make each picture in the book an absolutely faithful reproduction of the original print." The book is so planned that on the page facing each picture there will appear "a critical appreciation and information concerning the camera, lens, and process used in making the original print."

In its announcement, Carl Zeiss, Inc., invites all users of Zeiss Ikon cameras to submit prints for reproduction in the book, and continues: "It is preferable that finished prints be submitted, but test prints or the original negatives will be suitable for consideration, and shortly after receipt of prints or negatives we will communicate with the entrant as to acceptance. There is no restriction as to subject matter, consideration of pictures being based on technical quality and merit in the particular branch of photography with which the picture is concerned. The maker of each print reproduced will be sent a copy of the book when published. "Zeiss Photography" will be copyrighted so that each photographer represented will be protected against unauthorized use of his picture."

## Developing With Hypo

WE know it sounds fantastic, but here's the proof. The paper used is Seltona, one of the daylight papers, which, as its name implies, is printed in daylight. A collodion self-toning paper, it will yield, depending on whether it is bathed in water or a salt solution before fixing, a variety of tones ranging from reddish brown or sepia to dark brown, purple, or blue.

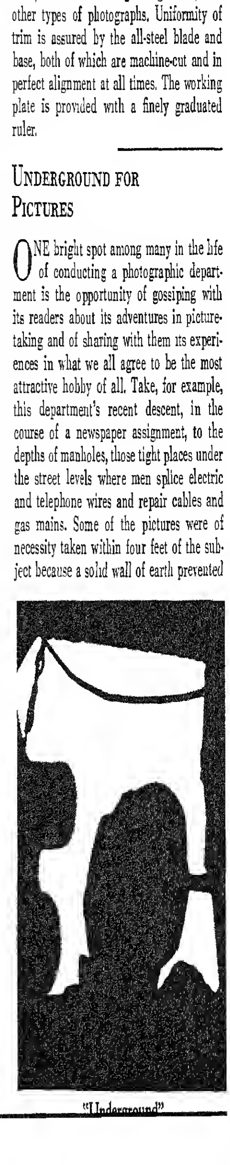
It sounds almost too good to be true, but no darkroom is needed because the printing is done by exposure to daylight, the progress of printing being observed from time to time until the full image is visible from shadows to highlight details. At this point the print is removed from the frame and slipped into a hypo bath consisting of two ounces of hypo dissolved in a pint of water, where it is allowed to remain 10 minutes. The print is then washed for an hour and the result is a normal sepia print. To obtain tones from dark brown to blue all that is necessary is to immerse the print in a bath of common salt; the stronger the salt bath the colder the tone, a normal salt bath consisting of two ounces of common salt in 20 ounces of water. The print is kept moving in this solution for five minutes, then washed in clean water for a few moments and finally transferred to the fixing solution, which is followed by an hour's bath in clean water. The paper comes in various surfaces and in sizes ranging from 3¼ by 4¼ inches to 8 by 10 inches, in single and double weight.

## Deckle-Edge Trimmer

IF you have been wondering how the professionals get those nice deckle edges on greeting cards, here is the answer. They use a steel trimmer, one of the best of which is the Chandler 10-inch All-steel Deckle Trimmer. It is simple to use, no more difficult, in fact, than an ordinary trimming board, and is ideal for deckle-edging snapshots, Christmas and greeting cards, and other types of photographs. Uniformity of trim is assured by the all-steel blade and base, both of which are machine-cut and in perfect alignment at all times. The working plate is provided with a finely graduated ruler.

## Underground for Pictures

ONE bright spot among many in the life of conducting a photographic department is the opportunity of gossiping with its readers about its adventures in picture-taking and of sharing with them its experiences in what we all agree to be the most attractive hobby of all. Take, for example, this department's recent descent, in the course of a newspaper assignment, to the depths of manholes, those tight places under the street levels where men splice electric and telephone wires and repair cables and gas mains. Some of the pictures were of necessity taken within four feet of the subject because a solid wall of earth prevented

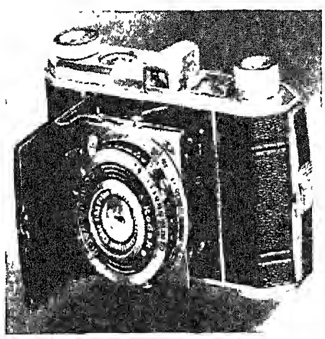


"Underground"

getting any farther back, and it is to the great credit of the candid 35-mm camera that pictures were possible at almost the full opening of one of the fast lenses characteristic of these cameras. Yielding to an inspiration, this department lay on its back at the bottom of the hole, a clean piece of canvas being considerately provided for the purpose by the subject, and shot the latter's head silhouetted in the manhole opening against the sky. The accompanying illustration is the result.

## New Retina

INCORPORATING several improvements over the earlier model, which was introduced in 1935, the new Kodak Retina, one of the finest outfits in the low price miniature field, is now available with a new



Retina—latest model

type of F:3.5 lens. The Kodak Anastigmat Ektar, as it is called, is said to be ground with the greatest precision according to a newly computed formula and to be notable for its critical definition even at its full F:3.5 opening. It is of 50-mm (2-inch) focal length and, according to its makers, "generous enlargements which are amazingly sharp and rich in detail may be made from the negatives produced by this new lens." The lens takes the screw-in mount Retina filters, N-1, N-2 and N-3, Kodak Retina Portrait Attachments A and B, and Kodachrome and other filters in the No. 17 slip-over mount.

Its outward appearance enhanced by a covering of tooled leather and a trim of satin-finish chromium, the new Retina includes the following features: 36-picture film capacity, except in the case of Kodachrome, which offers 18 pictures on the regular 1 by 1½-inch size film; Compur-Rapid shutter with nine speeds from 1 second to 1/500 second, as well as bulb and time and plunger release; enclosed direct-view optical finder; depth-of-focus scale; large knurled knobs for rapid film winding and rewinding (automatic stop accurately centers each exposure); exposure counter and film release; duplicate focus and diaphragm scales for horizontal and vertical pictures; hinged back with improved safety latch; tripod socket; die-cast metal case to assure rigidity. Dimensions, closed, 4¾ by 3 by 1¼ inches; weight, 15½ ounces.

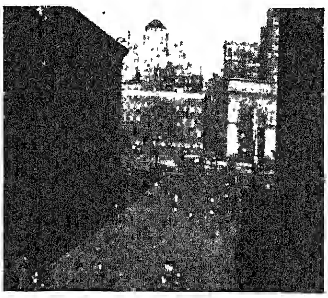
## Introducing Glims

A PIECE of gummed white paper coated with a luminiscent compound which when activated momentarily by white or other light rays will glow brightly in darkness—this constitutes Glims, a new and practical way to make use of the light-emit

ting properties of certain salts. An exposure of a second or a few seconds will cause the sheet to remain bright for hours or minutes depending upon the intensity and nature of the light source, which is learned by experience. The color of the light is green and for this reason Glims is especially recommended for use in processing panchromatic emulsions; but Glims has other uses also, such as illuminating a dark room timer, for labeling bottles of chemicals so that they may be found in the dark, for locating the darkroom light switch, and so on. Glims are obtainable in standard sizes, including 4 by 5, 5 by 7, and 8 by 10 inches. Other sizes can be made on special order.

## From A Moving Train

WE do not ask you to admire the accompanying picture nor would we be offering it here if it were not to indicate how simple a matter it is to shoot a subject from a moving vehicle, in this case an elevated railway train. A 35-mm camera was used and an exposure of 1/100 second at



Taken from a moving train

F:6.3 was made on superpan film as the train was rounding a bend which afforded the view here shown. You have to be ready, of course, by making the camera adjustments in advance and getting the camera poised for a quick shot. Owing to the unusual angle of view afforded or because one might not be coming by that way again, this is a method worth trying on worth-while subjects that you see from your train window and perhaps may never see again.

## Polarization Filters

THE introduction of polarized glass filters into the field of photography, announced in this department quite a while back, to take undesired reflection and glare out of picture-taking, has recently been extended to accommodate quite a variety of lenses, including the miniature camera types. These new filters are known as the Marks Polarization Filters and are available, unmounted, in the following sizes: 19 mm, 25 mm, 31 mm, 39 mm and 51 mm, other sizes required being made up on order. The filter material is said to be "the only polarizing plate consisting of a single crystalline sheet with effective polarization throughout the entire visible spectrum" and because of its high transparency requires only two times increased exposure or a single diaphragm stop. The filter may be used with or without color filters. The filter is mounted in a regular filter mount. In use, the photographer looks through the filter, revolving it slowly until the glare is either partially or totally eliminated, when it is placed over the camera lens at exactly the same angle. When using reflex cameras, the filter is

placed over the lens and revolved, the elimination of glare being watched in the ground glass. The filters may be used with movie or still cameras and with any film.

## Two Developing Trays

ONE cautious worker uses two developing trays of D76 solution in processing film packs. The 15-minute period which he allows for full development at 70 degrees, Fahrenheit, is occasionally found too short for one or two of the films. These latter he drops into the second tray to identify them as those which seem to be "coming up" more slowly than the rest and therefore requiring longer development.

This same worker, incidentally, seems loath to use the larger lens openings although his camera is equipped with an F:3.5 lens. He prefers to give longer exposures, even to ½ second and a second, rather than open up the lens diaphragm and court the danger of a shallow focal depth. This is laudable indeed and a practice that many would do well to follow—provided, of course, that the subject-matter will permit it and a tripod is handy to make the longer exposures possible.

## Trees in Winter

THE beauty of trees in winter ought not to be overlooked by the worker in search of the unusual. Shorn of the leaves that have taken a winter holiday, the branches are displayed to their full advantage, offering a variety of lines and shapes ranging from the thick trunk to the thinnest needle ends at the farther points. Etched sharply against an evenly lighted sky, they give the impression of fine needlework or cobwebs, the latter in all but design. The variety of lines and curves and forms gives sweep and movement such as is not easily found in trees when in full bloom.

Usually it is necessary to get fairly near the tree and to study its photographic possibilities by viewing the branches against the sky; often, also, the lower part of the tree will offer interesting pictures in the texture of the bark or the extraordinary arrangement of the thicker branches. Squirrels and birds lend a helping hand in many

Sun directly illuminating . . .

Against the brighter sky . . .

circumstances. Both pictures here shown were taken of the same tree, within a few minutes of each other, one with the light of the sun directly illuminating the subject, the other taken against the brighter part of the sky, giving a clean-cut silhouette. In all cases, when shooting during the full sunlight hours, a yellow filter will have to be used for a subject etched against the sky, although when the sun has begun to weaken this can be dispensed with.

## Thermometer That Signals

A THERMOMETER distinguished by the fact that it warns of danger ahead when the temperature falls too low or rises too high has been brought out under the name Photo-Thermometer. The signaling is done with color, the 50 degree point, the lowest temperature for effective fixing and safe washing, being green; the 65 degree point, the normal temperature for developing film, blue; and the 78 degree point, the melting point of gelatine, being appropriately red.

## Vertical or Horizontal

WHETHER to give your composition a vertical or horizontal "frame" does not always depend on the position of your main subject. Ordinarily, you would say that in a portrait of the "head-and-shoulder" or standing type the arrangement would be vertical, whereas in the case of most landscapes it would be horizontal. However, it is necessary not only to see that the subject is properly placed within the frame but that the mood of the occasion, or the photographer's interpretation of the mood, is also given full consideration.

Let us take, for specific discussion, the accompanying illustrations, "The Day's News." See how much more intimate is the horizontally arranged picture than is the vertical one. The pretzel seller's withdrawal from all that is going on about him, although people are constantly walking back and forth on the sidewalk before him, is here indicated much more strongly. The

"The Day's News"

inclusion of so much wall space also helps along the atmosphere of retirement, since it emphasizes the man's aloofness in a world of distractions. Also, the strongly prominent diagonal line of the jutting part of the wall offers support to the standing figure and, with the strongly lighted pretzel basket and box support, completes an attractive triangular composition. Contributing further to the general theme of quiet and exclusiveness in the midst of action is the contrast between the restless, relatively brightly lighted pattern of the wall and the greatly subdued lighting of the subject. It is this department's contention that in the vertical picture proper emphasis is overlooked.

## Tank Agitator

A NEW device for agitating the developing solution contained in a tank used for processing miniature type film is announced by the Central Camera Company. While it is said to work "effortlessly," permitting one to "continue work with one hand while the other agitates the tank when necessary," it must be noted that the device works by hand. Known as the Trojan Agitator, its distributors describe it as follows: "The agitator is made of one piece stainless steel with a round rocker bottom and a grip-tight rubber top. Being of stainless steel it cannot rust or corrode. Operation is as follows: Place tank on the agitator and with a slight motion of the hand, the tank will rock up and back in a circular motion, distributing the developing solution thoroughly over the film."

## THE SCIENTIFIC AMERICAN DIGEST

(*Continued from page* 183)

volved, the wider problem of "man performing the social activity science," for example; but that this, being on a different level of complexity and abstraction, will exhibit laws of a specific nature which have themselves to be the subject of study. This class composes *materialists who are not mechanists.*—Professor H. Levy in *Nature* (London).

### Saving Shavers' Tempers

DULLING of razor blades has been found to be caused by corrosion rather than by use. Recently a new method of preventing the corrosion of razor blades and hence saving the temper of the shaver has been devised which consists in adding to the shaving cream a material to prevent corrosion. The useful life of the blade is reported to be materially prolonged by the addition of potassium chromate or other corrosion inhibitors to the shaving cream. —*D. H. K.*

### "A Tale . . . Signifying Nothing"

*(Macbeth's Soliloquy)*

I.

In a younger and a plastic world
Peopled by monsters, horrible and grim,
Weird mixtures, part reptilian, partly birds,
Cold-blooded, sinister,
Swimming, crawling,
Plodding, heavily winging,
Lived finny Dimetrodonts, horny Triceratops,
Relentless Mosasaurs, unbelievable Pterodactyls,
And some of these—a dreadful, bestial race—
Were creatures which are called the Dinosaurs.
Unwieldy, tall as a mast,
Scaly, loathsomely thick,
With snaky neck and tiny brain,
A nightmare in rank flesh!
They ate, drank, propagated, slept;
They ate, drank, propagated, slept—
And millions of years passed.

II.

Then on one steamy, unimportant day
A group of Dinosaurs, a family,
Moving in sluggish pace to satisfy
One of the basic hungers of all life,
Came to a stream to drink,
Guzzled their fill and then,
Lingering a while upon the river bank,
Re-entered the forest, unwitting as ever.
But on the impressionable sand
At the meandering river's edge, they left
Huge three-toed tracks!
That very night the freshet came
And the brown waters overspread the banks,
Depositing their thick alluvial mud,
Filling the three-toed tracks up to the brim;
And in due time the waters receded,
Leaving the mud behind.

III.

Age succeeded Age,
And flood succeeded flood;
Layer after layer of river mud
Formed rocks as the ages passed.
Dinosaurs vanished away,
But still the tracks were there—
Buried, but still there!

IV.

And after more uncounted rounds of years
Mankind came into being,
And into lumpy bodies, in some mysterious fashion,
Souls were injected.
What was the source, and what the quality
Of those first souls? Awful imagining!
Could they have felt the dreadful pangs
Of suffocation in their beastly tenements,
Trapped and helpless, an agony of despair?
Well, that we cannot know!

V.

Meanwhile, by changes in the river bed,
By sun and wind, earth heavings, erosion,
The tracks left by that lethargic
Family of Dinosaurs are uncovered,
Exposed to view!

VI.

Ages on ages more have slowly passed,
And Mankind has developed to this day—
Our brains a great deal larger in proportion
Than were the brains of those great Dinosaurs.
We eat, we drink, we propagate, we sleep,
We eat, we drink, we propagate, we sleep.
It's true we do a little more—that is,
We write, and paint, and play stringed instruments,
Design machinery, and raise huge piles of stone,
And build fine bridges for the floods to crumple,
And really think quite highly of ourselves!
But tell me, please, what do we leave behind
As lasting as the tracks of Dinosaurs?

—*Enid Crawford Pierce*

### Toward an Aroused Public Opinion

SO far as the lay public is concerned, the greatest factor in the control of cancer and tuberculosis has been the publicity these diseases have received. Press, magazines, placards, radio, all have made familiar the early symptoms, emphasized the consequences of neglect and the necessity of reputable medical care, and, as for tuberculosis, laid stress on the public health menace. Any adult who can hear or read has been repeatedly told, in brief but telling slogans, that "any lump in a woman's breast may be cancer"; "don't spit—spitting spreads disease"; "beware of the chronic cough—it may be tuberculosis"; "consult your doctor at once if you have so and so." The people are, to use the advertising man's phrase, cancer- and tuberculosis-conscious.

The dissemination of similar knowledge concerning syphilis has, however, been left almost entirely in the hands of the advertising quack. Legitimate organized medicine and public health officials have done little or nothing to inform the public of syphilis, its prevalence, what it is, what its symptoms may be, how it infiltrates all levels of society, how it attacks innocent women and children, how and where it may be treated, what may be the consequences of neglect. Most laymen know none of these things.

If the people have this information, more of them when infected will consult their doctors, and, of greater public health importance still, more of them will come

early and will stay under treatment. An aroused and organized public opinion will aid in the elimination of the quack, charlatan, and cultist. Drug-store treatment may be at least partially controlled by co-operation between public health officials and the pharmaceutical profession.—*Dr. Joseph Earle Moore in the Journal of the American Medical Association.*

**ICE BY WIRE**

SALES of electric refrigerators in 1936 reached a new high mark of 2,037,746. This figure represents an increase of 30 percent over those sold in 1935. Last year's sales bring the total number of electric refrigerators in use in the United States to 9,287,746.

## Industry Uses Precious Metals

EXPENSIVE metals having unique properties frequently pay for their added cost by saving operating expenses in chemical plants. Recently the substitution of the rare metal tantalum, once familiar in the filaments of electric lamps, for a cheaper metal increased the cost of a piece of chemical plant equipment 150-fold. Yet output was doubled in the tantalum unit and the product was of superior quality, so that this precious metal paid for its enormous cost in the short space of eleven months. The special value of tantalum is that it is not corroded by many chemicals, nor do surface films of "rust" form on it to waste heat. Silver has been found similarly useful in heaters and coolers used in the food and beverage industries in addition to numerous specialized chemical applications. Not only are operations in plants made more economical by the use of these metals, but the high scrap value of equipment made from them offsets first cost.—*D. H. K.*

## Where Map Students Had Their Way

AS everybody knows, it is fascinating fun to pore over maps and globes, and a great many shortened trade routes have thus been worked out, to the world's everlasting benefit. Likewise, however, some other shortened routes have been worked out to the world's everlasting chagrin. Give a man a map, let him hatch an idea for a shortened trade route, and the idea so fills his field of vision that it sometimes excludes everything else, including such minor trifles as practical economics. If you get out a map—or far better a globe which does not distort—you will see how much shorter it is from Canada's great wheat belt to Great Britain by way of Hudson Bay and Hudson Strait than by the more southern route. So appealing was this idea that human nature worked out in Canada just the same as it does in U.S.A., and a government railroad was built to Hudson Bay. Now, after some years of operation, we find in *Railway Age* the following brief account of the actual results:

"Fort Churchill, Canada's farthest north railway grain terminal, and the Hudson Bay Railway are receiving a rough ride. Both the Conservative and the Liberal parties at Ottawa a few years ago engaged in a competition of voting for the western vote and the result was that both of these parties became committed to building a railway outlet for grain in Hudson Bay. The Hudson Bay Railway was built at a cost of at least 60,000,000 dollars and the terminal facilities, first began at Port Nelson and then moved farther north to Churchill, cost at least 10,000,000 dollars more. In the six years of operation up to this fall a total of a little over 16,000,000 bushels of wheat has been moved out of Churchill by vessels to Europe.

"Figuring the total cost of the grain route for western growers at not less than 70,000,000 dollars, the cost per bushel of wheat actually moved up-to-date is four dollars, and this in spite of a highly efficient management and exceedingly generous marine insurance rates on boats which have to traverse Hudson Strait which is regarded as highly hazardous."

Hudson Strait as a navigation route combines, or rather, *compounds*, icebergs with a very high, rapidly moving tide. Neither of these "minor inconveniences" showed on the map. New York State once built a barge canal to carry America's grain to the seacoast and here, too, various "minor matters" did not show on the map. Now a canal is being strongly urged for Florida. On the map it looks fine, and it is said to look fine to some local communities.

Human nature appears to be fairly similar, the world over.

## Better Soap

ADDITION of small amounts of salt, sodium sulfate, or sodium phosphate to soap, the alkalinity of which has already been adjusted to give the best results, improves its washing effectiveness. Five percent of added disodium phosphate has been found to increase brightness of the washed samples of goods more than 27 percent, as compared with soap alone.—*D. H. K.*

## On Not Being Scientific

IT may sometimes be unscientific to be too "scientific" about the food given to infants. We recall an article in the *Journal of the American Medical Association* ("What Infants on the Self-Selected Diet Experiment Eat," 1930, pages 137-146) which described experiments in which babies were daily surrounded with a wide variety of foods, some of them not usually regarded as suitable for infants, and allowed to grab at will. In many cases the infants chose and ate immense amounts of some one food—enough, according to some solicitous grandmothers, to kill them—and exactly *nothing* happened. The experiments possibly tended to bolster the theory that infants, like other animals, instinctively know what is good for them—what their bodies crave—and eat it if they can get it.

The following paragraphs are from an article in the same journal, 1936, pages 765-768, by Dr. Clifford Sweet, of Oakland, California, and we reprint them because we like their common sense as applied to normal children:

"The young mother must be taught that the formula prescribed for her infant is made sufficient to allow him all the food

he wants and that it should be offered at prescribed intervals. When additional foods are prescribed they should be given in small amounts, and, if they are resisted, a taste for them should be taught gradually. Human nature has always yielded more readily to seduction than to violence.

"Few mothers realize that the components of a balanced diet need not all be eaten every day. They must be assured that a commonly taken and necessary food should be omitted without opposition for days whenever the child tires of it; the child's body has abundant stored-up supplies to draw on during the holiday, and when he needs the food he will take it gladly.

"Children who are allowed to omit a food at will do not develop a lasting dislike for it as they do when it is forced on them against their will.

"*Malnutrition has been over-emphasized* until it has become a menace to the peace of mind of mothers.

"Not every child needs a quart of milk daily and he should be given credit for the milk he takes with other food as well as that drunk.

"Temporary loss of appetite may mean nothing except that the child is not hungry, while a more prolonged absence usually is the first symptom of illness and the most dependable symptom of the need for a careful physical examination.

"The strict interdiction of all foods from his diet which the child says 'I do not like' for a few days or weeks often changes at least the greater number of them to the highly desirable list for which he will then ask."

## World's Largest Vulcanizer

TO meet the ever increasing demand for rubber-lined tanks throughout the steel, chemical, electroplating, and other acid-handling industries, The B. F. Goodrich Company have installed in their plant a new high-pressure steam vulcanizer which is said to be 75 percent larger than any similar unit now in use.

The vulcanizer was fabricated in the shops of the Adamson Machine Company and the Biggs Boiler Works. It weighs 110 tons, is 45 feet long and has a clear inside diameter of 15 feet. Designed to operate at 100 pounds steam pressure, this 65,000 gallon unit is of all-welded construction with the exception of the cast-steel door rings and door head, which are attached with rivets.

It has a vertical rising door operated by screws with motor power. A standard gage 90-pound railroad track is installed in the vulcanizer so that tanks can be moved in and out on specially constructed steel cars.

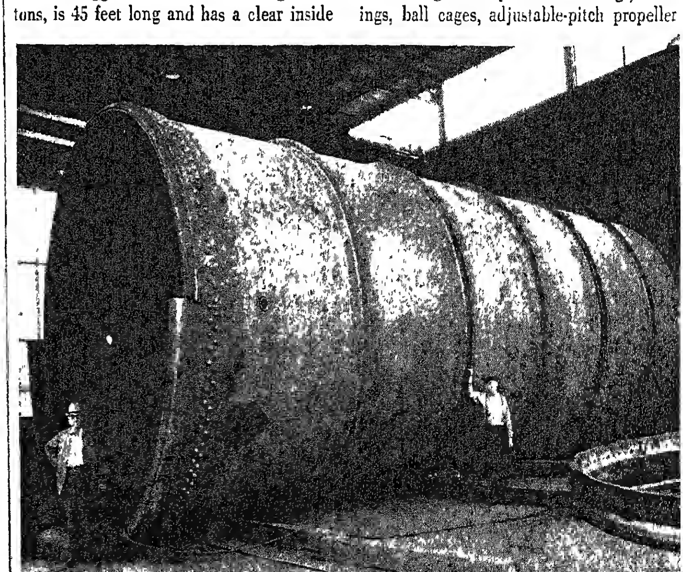
The primary advantage of this mammoth vulcanizer is that it will now be possible to complete large rubber lined tanks in considerably less time than was previously required.

## Beryllium-Copper Alloys

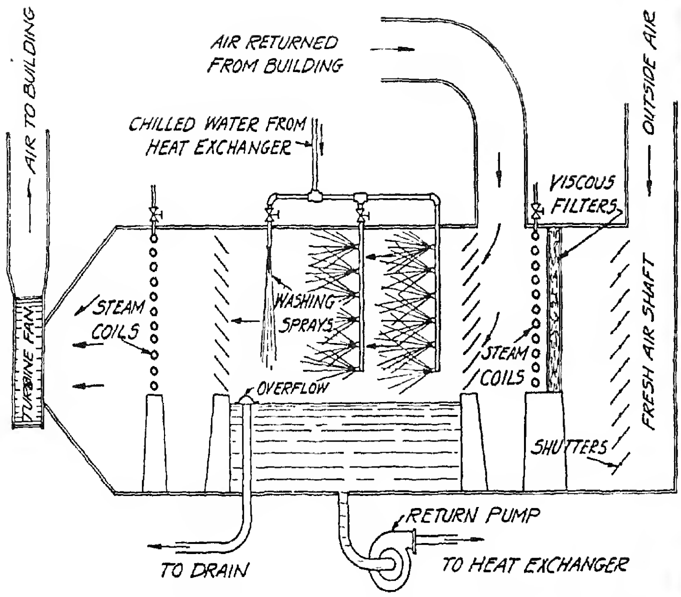
BERYLLIUM, the rare element contained in the gem stones, emerald and beryl, is now produced in commercial quantities and used for imparting valuable properties to copper alloys. These alloys, containing only about 2 percent of this rare metal, have rapidly developed to great commercial usefulness. In summarizing developments in this field, Horace F. Silliman recently made the following statements.

"In many cases beryllium-copper has been substituted for other copper alloys and for steel, even though it is relatively more expensive than the older alloys. The wrought alloy goes into the manufacture of springs and other articles having spring parts. Springs made from this alloy have the corrosion resistance of copper plus high resistance to fatigue, high resilience, and low hysteresis loss. In addition to coiled springs and flat springs, the list of spring-like parts includes diaphragms, fuse clips, current-carrying contact springs, spring washers, switch blades, and many other articles. The alloys are particularly adapted for instrument parts because they are non-magnetic.

"The comparatively high hardness and shock resistance of beryllium-copper permits it to be used for non-sparking hand tools such as hammers, chisels, wrenches, wrecking bars, drift pins, scrapers, and the like, and for pistons in vibrators and firing pins in firearms. The good wear resistance is advantageous in precision bearings, bushings, ball cages, adjustable-pitch propeller



Shell of the huge vulcanizer for making rubber-lined tanks



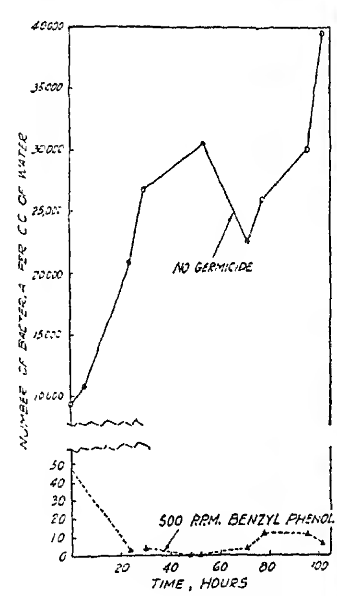

Bacteria in re-circulated conditioned air systems such as this can be controlled

hub cones, gears, and sliding contacts. Other commercial uses at present are platers' bars and cores, retractable landing-gear parts, surgical instrument handles, woven wire cloth, bolts and nuts, molds for plastics, and valve parts.

"In about four years these remarkable alloys of one of the oldest and one of the newest of the metals used by man have assumed considerable commercial importance."—*D. H. K.*

## Preventing Infection with Conditioned Air

MODERN air-conditioning systems which re-use the air of the conditioned space and allow it to accumulate bacteria appears as a new menace to health, but fortunately one easily controlled. Addition of germicidal agents which kill germs but do not increase corrosion of equipment effectively reduce the number of bacteria in the water used to wash air. Organic disinfectants of the benzyl phenol type have been found particularly effective.—*D. H. K.*




*Upper chart:* Rise in bacteria in re-circulated conditioned air. *Lower:* When germicidal agent is used

> **ELECTRICITY**
>
> THE people of the United States now use over four times as much electric power per capita as the average for the rest of the world.

## Dental Cavities and Diet

IN spite of the facts that there are more dental clinics, that many more people brush their teeth, and that more dental treatment is practiced today than ever in the world before, dental disease seems to be as prevalent as it has ever been, especially among civilized peoples. The experimental work of Mrs. Mellanby has shown that there is an intimate relationship between the diet and the structure of the teeth in both animals and man, and that there is similarly a close relationship between structure and liability to caries in man. It remained to be proved that the incidence and progress of the disease could be influenced by alterations or additions to the diet.

The final report [The Influence of Diet on Caries in Children's Teeth (Final Report). By the Committee for the Investigation of Dental Disease (assisted by Alan Deverall and Mabel Reynolds)] of the Committee for the Investigation of Dental Disease describes the influence of diet upon caries in children's teeth and shows that the teeth, like other organs of the body, are strongly influenced by nutritional factors brought to bear upon them, whether through their blood supply or the saliva. The dental decay that developed in the children receiving an addition of Vitamin D to their diet was definitely less than in the control children not receiving extra vitamin, and its influence in inhibiting the initiation and spread of caries was especially impressive when the addition was made during the period of development and before full eruption of the teeth.

The investigations were made in three

similar institutions. Three experiments were carried out. In the first, the three institutions had daily additions to the diet of treacle (28-42 gm.), olive oil (14-21 c.c.) and cod-liver oil (14-21 c.c.; 50-100 units of vitamin D per c.c.) respectively. In the second, carried out in one institution only, one group of children received the olive oil and the other Vitamin D in olive oil (625 units per c.c.: 14-21 c.c.). In the third, the children were younger (2-5 years old) instead of 5-14 years old, and the additions were treacle, vitamin D in olive oil. and cod-liver oil in daily doses of 7 gm. or 7 c.c., in three different institutions. Although about 1600 children were under observation for varying lengths of time, the number who received the special additions for the full period of three years was much less.

Summing up the results of these extensive experiments, it may be concluded that a relatively high intake of vitamin D can do much to diminish the incidence of caries if the vitamin is given during the period of development of the teeth: that a beneficial effect may be obtained if it is given at a fairly late stage of development; and that even when it is given after the eruption of the teeth, the onset and spread of caries are delayed.—*Nature* (London).

**Oo-o-ooh!**

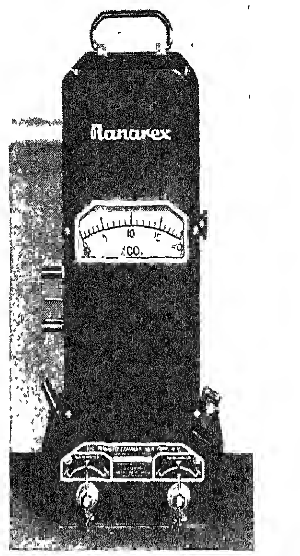
**100,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000 represents the largest number with a real meaning. This figure—the numeral one followed by 110 ciphers—is Dr. Karl T. Compton's estimate of the total number of the smallest things in the universe (the electrons) which could be packed side by side into the largest volume so far measured (the limits of the present known universe).**

## $CO_2$ Detector

A PORTABLE line of instruments for determining the $CO_2$ content of flue gases of boilers and furnaces, and also for determining the air-fuel ratio in the exhaust gases of internal combustion engines, in order to permit adjustment of the air-fuel ratio for maximum efficiency and best performance, has been announced by the Permutit Company. This instrument determines the $CO_2$ content of air-fuel ratio by a mechanical principle based on the fact that the specific weight of exhaust or flue gases varies with changes in air-fuel ratio or $CO_2$ content. This principle has been well proved by Ranarex $CO_2$ recorders long in use in both stationary and marine steam power plants.

In order to obtain a substantial force as a means of measuring the specific weight of the exhaust or flue gas, a rotating motion is imparted to the gas by means of a motor-driven fan revolving in a chamber. This fan blows the gas against the blades of an impulse wheel, thus producing a torque on the shaft of the impulse wheel in proportion to the air-fuel ratio, or $CO_2$ content. Changes in fan speed, temperature, humidity, and atmospheric pressure are automatically compensated for by a comparing torque produced on another impulse wheel by air to which a rotating motion is imparted in a second chamber by a second fan driven by the same motor. The two impulse wheel shafts are coupled together by means of a balancing linkage, actuating the indicator, the scale being calibrated in terms of air-fuel ratio or $CO_2$.

The instrument may also be furnished with scales reading in terms of specific




Portable $CO_2$ indicator

gravity for use in gas plants or natural gas fields. For use with internal combustion engines a vacuum or combined vacuum and pressure gage is built into the instrument to permit measurement of the pressure in the intake manifold. The Ranarex gas analyzer, by reason of its mechanical principle and rugged construction, is a practical instrument for hard service. It is readily portable and can be furnished to operate either on lighting circuits or on standard six-volt automobile batteries.

## Quality of Cigarette Smoke

APPLYING a method of mechanical smoking of cigarettes, research workers in one of the large tobacco companies have learned important facts about the quality of smoke and why certain smokes are harsh and others smooth. In summarizing their results in a recent issue of *Industrial and Engineering Chemistry*, they say: "The most marked difference in the smoke of various types is found in its relative acidity, and this is related to the quantity of sugars in the tobacco. These may be the natural reducing sugars of the leaf, or added glucose, invert sugar or sucrose. Although sugars contribute somewhat to the quantity of smoke acids and increase slightly the proportion of formic acid, their principal function is reducing base formation. The alkaline tobaccos are definitely rich in aroma, which contributes to smoke quality when the excessive formation of bases is restrained. The added sugar seems to reduce ammonia proportionately more than nicotine. The paper in which a cigarette is wrapped yields some acid on combustion. However, the pro-

portion of paper to tobacco is small and relatively constant (about 4 percent).

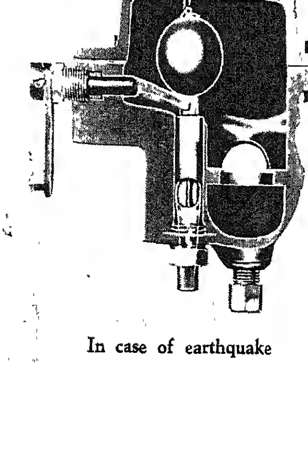
"The association of the composition of cigarette smoke with taste sensations leads to some generalizations concerning palatability and chemical constituents. When smoke is alkaline or in too high concentration, the bases act as irritants, causing a choking sensation and frequently stimulating the cough reflex. Yet, without a sufficient amount of bases, smoke is flat and lacking in character. Nicotine and ammonia are not interchangeable in the base fraction. As the proportion of nicotine increases from the lower extreme, the smoke (weak and somewhat irritating) becomes smoother and more satisfying; as the other extreme is approached, it becomes heady and deficient in flavor and sensibly more acid. These changes may be masked, however, by added flavor or, as in the case of the Turkish cigarette, by the natural aromatics of the tobacco plant. The acid type of smoke is described as harsh or sharp. Tongue bite and throat irritation are more noticeable. Formic and acetic acids comprise the greater portion of smoke acids and, through their local irritant action, seem to be responsible for the effects noted."—*D. H. K.*

## Earthquake Fire-Valve

APPROXIMATELY 5 percent of the damage done to San Francisco at the time of the earthquake was due to the earthquake itself, the remaining 95 percent having been caused by the fire which resulted mainly from the breakage of gas pipes and gas mains.

Much work has been done by architects and engineers to prevent a recurrence of such a disaster. In regions subject to earthquakes, building codes and building methods have been radically revised to prevent, as far as possible, the danger to lives and property caused by falling walls. This is extremely important because fire insurance policies usually state that an earthquake may technically render the policy instantly void. Until walls can be so built that earthquakes will not topple them, the property owner is faced with the problem of preventing fire on his premises. And this is often impossible because an earthquake may smash all sprinkler and water lines.

A company on the West Coast—the Water Works Supply Company, Inc.—has, therefore worked out a simple and most ingenious valve, to be placed in the gas feeder line, which operates to cut off the gas immediately there is an earthquake or a serious shaking of the building. The Fire-Kwake valve consists essentially of a non-corrosive metal ball which normally rests upon the top of a small pin, so that when shaken, it falls to one side and seats itself tightly into a circular hole. Seated therein it effectively bars further flow of gas. The ball is attached by a small chain to a screw plug immediately above its pin rest. To reset, it is only necessary to remove the screw plug, lift the ball, and drop it upon the pin. In addition to the automatic earthquake shut-off feature, the valve is provided with a thermostatic control, comprising a thermostatic valve at the bottom of the pin support, and, in the intervening space, a fusible metal link. Should the area surrounding the valve become heated to the danger point this control also automatically drops the ball to cut off the gas.



In case of earthquake

### FISH-FLOUR

**A HEALTH decline among Japanese students, due to their adoption of the American custom of eating a snack of bread-and-jam, has inspired Japanese research to develop a fish-flour (without the accompanying disagreeable smell and taste) for those who still feel that they wish to eat bread similar to that of the Occident.**

## Preventing Cyanide Poisoning

CONTROL of the sale of lethal poisons which are used in industry has been found to reduce but not prevent deaths from them. The Japanese Department of Home Affairs is sponsoring a movement to add a disagreeable odor and distinctive coloring to potassium cyanide in the hope of reducing accidental and suicidal deaths caused by it.—*D. H. K.*

## Highways Will Be Safer: Driver Remains a Problem

THE main highways of the future are pictured by Thomas H. MacDonald, Chief of the United States Bureau of Public Roads, as broad, unobstructed surfaces over which traffic can flow smoothly with safety and comfort. In discussing the work the state and federal governments are doing to make the main highways safe under modern traffic conditions, he said:

"There will be provided for motor vehicle operators of the future roadways that can be used with safety by the reasonably careful driver.

"The roads of the future will have traffic lanes wide enough for ample clearance. That means that at the speeds we now foresee we will want a 22-foot road for two-lane traffic. It will have shoulders wide enough for stopping, with no deep side ditches. Its surface will be consistently smooth and non-skid. It will be so designed as to alignment, profile, and cross section that at no place will the traveler suddenly encounter the unexpected or come into traffic so slow that if impatient he will be tempted to take a chance.

"Where the traffic is so heavy that two

lanes will not carry it, there will be four-lane roads. But they will consist of two lanes on each side of a center parkway; there will be no chance to meet opposing traffic as there is in the present road with four contiguous lanes. Most engineers endorse the principle of separated-lane roads wherever more than two lanes must be provided to carry the traffic.

"More highways will be lighted, no doubt, but the amount of lighting will depend on the funds made available for highways and on whether we find that we can spend the money in any other way that is as effective in preventing accidents. Greater dividends in lives saved per thousand dollars of expenditure would result from construction of footpaths along heavily traveled routes and from separation of grades at intersections of main traffic arteries than from a general lighting program.

"However, lighting will have a place in the future program. Old methods of lighting are inefficient and of doubtful value, but marked improvements are being made. We must experiment to produce a thoroughly efficient system of lighting. We must also light experimental sections of highway and accumulate accident records as a guide in determining where the expense of lighting is justified. I think it is clear that lighting for all roads is not possible now. Installation is not expensive, but *operation would cost more than all the other items of highway maintenance put together.* And, as it is, most highway departments do not have enough maintenance money to keep the highways in as good shape as they would like.

"We will have pedestrian walkways at a safe distance from the highway surface; also, on heavily traveled roads we will have surfaced areas where busses may pull out of the stream of traffic to receive and discharge passengers; and turn-outs for R.F.D. carriers to use in serving the boxes of their patrons. The danger spots which cannot be eliminated by reason of great expense will be plainly indicated by signs that will advise the motorist what speed *is* safe.

"The highway engineer's part in promoting highway safety is to design highways that are safe for reasonably careful drivers; that is, highways as safe as they can be built with the funds available. They will be highways on which you can pass an overtaken vehicle with safety, highways that will not confront a driver with hazardous conditions without ample notice or warning. When this has been accomplished, the highway will occupy its proper place in supporting the safety triangle of the road, the vehicle, and the driver. But finally, safety will always rest with the driver."

## Some Pull!

DEVELOPMENT at the Massachusetts Institute of Technology of a compact magnet capable of producing the highest permanent magnetic field ever attained has opened the door to a new and significant field of exploration in the world of matter. The new magnet was designed by Dr. Francis Bitter of the Department of Mining and Metallurgy, and the magnetic field produced in its first test was 150,000 times more intense than the earth's field, the effect of which is commonly observed in its influence on the compass needle.

Scientists have long known that strong magnetic fields change or distort matter, thus altering its properties in a great variety of ways. For such fundamental research magnetic fields of great intensity are necessary and the quest for methods of producing them has been carried on actively for many years. Until recently, however, the types of apparatus available

The newly developed high-field-strength magnet is inside the jacket on which Dr. Bitter is leaning

only partially met the demands, either because the intensity of the desired fields lasted for only a fraction of a second, or because, as in the case of the iron-core magnet, the field covered too small a volume for practical applications.

Technology's new magnet was designed to produce fields of at least 100,000 gauss, the unit of measurement for magnetic fields, and in its preliminary test in which no attempt was made to develop its full capacity, a field of 75,000 gauss was produced and maintained for a considerable period of time. The enormous amount of power required to produce this field was made available to Dr. Bitter through the co-operation of the Edison Electric Illuminating Company of Boston, which placed at his disposal laboratory space in one of its large substations. With controlled direct current up to 12,000 amperes at 250 volts to draw upon, the first test was successfully carried out with a maximum current of 8000 amperes producing a field of 75,000 gauss. The intensity of the earth's field is slightly less than half a gauss.

The copper coil of this unique magnet, which is only eight inches long, six inches in diameter, with an inside diameter of one inch, is enclosed in a bronze shell. A water cooling system is employed to dissipate the enormous heat generated when an amount of power sufficient to supply a small town, or more energy than is needed to operate 50 automobiles of 80 horsepower each, is poured into this amazingly small piece of apparatus. Without water cooling the magnet would melt and be rendered worthless within one second.

Because of the very heavy power load and the strength of the magnetic field, precautions were taken to protect the research

staff and the electrical machinery. The two huge bus bars carrying the current to the magnet each consisted of six strips of copper six inches wide and a quarter of an inch thick bolted together.

### COLDS

**ONE of the latest estimates states that the common cold costs the United States a half billion dollars each year.**

## Farm Woods Increase

ONE result of the depression has been to increase the areas usually classified as farm woodlands. This has occurred chiefly in the industrial states where lack of employment in cities caused migration to cheap lands where a living could be eked out from the forest and small areas of tillable ground, says the New York State College of Forestry at Syracuse University.

According to the United States census, during the five-year period between 1930 and 1935 woodland on farms increased 23.7 percent or approximately 35,529,000 acres. This brings the total farm woodland area in the United States to 185,000,474 acres.

These figures indicate the importance of farm woodlands as a source of timber. The Forest Service estimates that approximately one third of the total cut of timber is produced from farm woodlands. A larger acreage is devoted to farm forests than any other land crop. The increase in the forest area on farms was far in excess of the increases of the total farm area which was only 7 percent as against 23.7 percent for woodlands. This increase in farm forests also is partially accounted for through the abandonment of cotton and corn fields in the South and to a small extent in other sections.

## Fatty Oils as Motor Fuels

IN Belgium, contests for prizes offered by the Royal Automobile Club have shown that automobiles and particularly trucks can be operated on cotton-seed oil and palm oil. A five-ton truck using cotton-seed oil is reported to consume about 27 liters of the oil as fuel per 100 kilometers, equivalent to 8.71 miles per gallon, or 11.5 gallons per hundred miles.—*D. H. K.*

## Protective Coating for Metals

MOST people are familiar with the microscopic coating that has been used for years on certain silver articles, such as candlesticks, to prevent tarnish. This principle has been expanded in the development of a new transparent protective coating for all bright metal surfaces. The new coating, called Cellufoil, announced by the Evans-Walton Company, when applied as a liquid, hardens quickly and becomes a tough, adhesive top layer. It is said to preserve indefinitely the natural bright luster of any of the usual plating metals such as chrome or nickel.

Cellufoil has a nitro-cellulose base and can be applied by either brushing or spraying. It is being marketed in 4, 16, and 32 ounce, and one gallon containers through accessory chain stores and repair shops. Its price is reasonably low.

The chief virtue of Cellufoil is that it is not affected by weather conditions or normal temperature changes. It does not start to break down under a temperature of 270 degrees, Fahrenheit. Because of this weathering ability it is being recommended for all the metal parts of automobiles and for the brass and copper of boats, in which latter service it protects against the harmful and corrosive action of salt water and air.

## Removable Printing Ink

TO make easier the recovery and re-use of the wood pulp of newspapers and other printed matter, German chemists are reported to be developing an ink which does not contain lamp black and which consequently will be more easily removed from the paper.—*D. H. K.*

### MORE DUST

**NEARLY a billion particles of dust—or 900 million, if we must be exact—pass through the lungs of city dwellers each minute. Of these microscopic particles 90 million are left behind in the lungs, according to Dr. Helmut Landsberg of Pennsylvania State College.**

## Primitive Paradox

PAPUAN natives are becoming sport-conscious and are discarding their old "skull-crusher" clubs for golf clubs, according to J. T. Jennings, member of the Australian Parliament who has recently been on a trip to New Guinea and Papua.

"Some of the magnificent specimens amongst these people," said Mr. Jennings, "could, with proper coaching and training, become athletes equal to the world's best, worthy to compete in the Olympic Games."

The Papuans are the most air-minded people living. On the gold-fields in the interior, 50 natives can be seen riding in one airplane. They know no other kind of transportation. The Papuans have never seen a train or a taxicab but they know all about flying.—*Australian Press Bureau.*

## Automatic Transmissions Pass Million Mile Service Mark

AUTOMATIC transmissions for motor vehicles finally passed out of the speculative and experimental state with advices from Chicago that 101 automatic transmissions in regular bus service there have accumulated a total of some 1,300,000 miles of operation with the total building up at the rate of some 20,000 miles per day.

The transmissions, of the Banker "Mono-Drive" type, are installed in 101 new rear-engine, double-deck motor-coaches produced by General Motors Truck Company and operated by the Chicago Motor Coach Company. A feature of the transmission is that it eliminates both the gearshift lever and the clutch pedal. Thus the operator has only two foot controls: accelerator and brake. A

particular advantage of this arrangement is said to be the material increase in safety of operation, not only due to the fewer number of controls but also because with this type of transmission the driver does not have to take his hands off the steering wheel to operate the vehicle.

Gears are shifted by releasing the accelerator pedal momentarily, the transmission automatically shifting into the correct ratio for the speed at which the vehicle is operating. When the vehicle stops, the clutch automatically disengages, re-engaging only when the accelerator is again depressed.

Of the 101 buses in this service, the first vehicle to go into operation has already operated over 46,000 miles.

It is reported that one of the largest automobile parts manufacturing concerns has been granted a license to manufacture the transmission for original equipment in passenger cars and taxicabs.

# CURRENT BULLETIN BRIEFS

*(Bulletins listed as being obtainable through Scientific American can be supplied only by mail)*

THE AMATEUR ARCHEOLOGIST, by H. M. Wormington. Archeologists at a noted museum tell the layman what to do with regard to archeological finds. *The Colorado Museum of Natural History, Denver, Colorado.—10 cents.*

THE OXYGEN LANCE is an 8-page illustrated pamphlet which presents in convenient form a description of the oxygen lance and how it is used and what it will do in various industries. For many years used in emergency operations, the lance is now widely employed for countless jobs of a routine nature. *Write for Bulletin 337A, Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

LEGAL ASPECTS OF MILK CONTROL, by James A. Tobey, Dr. P.H., covers such phases of the subject as reasons for the public control of milk, sanitary regulations, testing of dairy cattle, pasteurization, and containers for milk. An excellent bibliography is provided. *International Association of Milk Dealers, 309 West Jackson Boulevard, Chicago, Illinois.—$3.00.*

GEM STONES, by Sydney H. Ball. The gem stone industry in the U.S.A., for 1935. *Superintendent of Documents, Government Printing Office, Washington, D. C.—5 cents (coin).*

SMALL BORE RIFLE HANDBOOK describes a number of modern rifles and their ammunition, and covers such aspects of target shooting as aiming, firing positions, the use of the sling, trigger squeeze, windage, and so on. It gives many hints that will be of benefit to the small bore enthusiast. *Write for Bulletin 337B, Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

VACATION IN THE SKIES THIS YEAR is a beautifully produced booklet, including a folded insert, describing all-expense tours with the airplane as a means of getting to and back from your vacation land. *Eastern Air Lines, 1775 Broadway, New York City.—Gratis.*

LESSONS IN ARC WELDING is a series of typewritten sheets bound in a convenient cover. It presents in simplified form instructions for operators of various types of welding equipment. *The Lincoln Electric Company, Cleveland, Ohio.—50 cents.*

ELECTRIC POWER ON THE FARM, edited by David Cushman Coyle, deals with the usefulness of electricity on farms and with the present movement to electrify rural America. It is illustrated with many photographs and drawings that directly pertain to the text. The booklet will also be of interest to others than farmers who are concerned with broadening the applications of electrical power. *Superintendent of Documents, Government Printing Office, Washington, D. C.—25 cents (coin).*

GROUPS OF PLANTS VALUABLE FOR WILDLIFE UTILIZATION AND EROSION CONTROL, by W. L. McAtee, Bureau of Biological Survey, puts forth the results of a careful study of the subject. *Superintendent of Documents, Government Printing Office, Washington, D. C.—5 cents (coin).*

CATALOG No. 190—1937 lists radio parts particularly designed for use by amateurs, service-men, and experimenters. It includes hundreds of items that are usually difficult to find. *Insuline Corporation of America, 23-25 Park Place, New York City.—Gratis.*

A KEY TO THE RATTLESNAKES, WITH SUMMARY OF CHARACTERISTICS, by Laurence M. Klauber, Curator of Reptiles and Amphibians, San Diego Society of Natural History. For use in the scientific identification of varieties of rattlers. *San Diego Society of Natural History, Balboa Park, San Diego, California.—$1.00.*

ENGINEERED POWER TOOLS lists, in 48 pages, several complete lines of equipment for the home workshop, as well as the small factory. It covers such tools as lathes, circular, jig, and band saws, drill presses and jointers. It also lists various accessories. *Write for Bulletin 337C, Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

THE OBSERVER'S HANDBOOK FOR 1937 is a compact summary of the position of the planets, eclipses, sky and astronomical phenomena, month by month, for this year. Numerous other features, including four star maps, are included and we always recommend that every telescope owner buy this useful booklet each year. *The Royal Astronomical Society of Canada, 198 College St., Toronto, Ontario, Canada.—25 cents.*

THERMAL EXPANSION OF TYPICAL AMERICAN ROCKS, by John H. Griffith, Research Engineer. Results of an investigation to determine the coefficients of expansion of about 100 representative American rocks. *Director, Iowa Engineering Experiment Station, Ames, Iowa.—Gratis.*

# LEGAL HIGH-LIGHTS

## Patent, Trademark, and Related Legal Proceedings That May Have a Direct Effect on Your Business

By ORSON D. MUNN, Litt.B., LL.B., Sc.D.
New York Bar
Editor, Scientific American

### Trade Marks—Second Hand

A MANUFACTURER or dealer may recondition used articles of merchandise of another manufacturer but in reselling the reconditioned merchandise he can not employ the trade mark of the original manufacturer.

This question recently came before a United States District Court in a case involving a well-known brand of spark plugs. In that case the spark plug manufacturer was the plaintiff and he sued the defendant, charging among other things that the defendant was infringing his trade mark by selling reconditioned spark plugs bearing plaintiff's trade mark. The spark plugs were originally manufactured and sold by the plaintiff and after they had been used for some time were discarded by the user and purchased by the defendant who reconditioned the spark plugs and then resold them without removing plaintiff's trade mark. The defendant, however, had taken the precaution of stamping the word "Used" on the spark plugs, and the boxes in which the spark plugs were resold by the defendant contained a printed statement indicating that they had been reconditioned by the defendant.

In spite of these precautions the court held that the defendant had infringed the plaintiff's trade mark by selling the reconditioned spark plugs with the trade mark thereon and ordered that the defendant should be restrained from thereafter selling the reconditioned plugs without first removing the trade mark therefrom. In reaching this conclusion the court found that the reconditioned spark plugs did not represent the high quality of plaintiff's product and in this connection the court stated:

"The plug here involved has undergone such changes since its manufacture and sale by the plaintiff that it no longer can be said truly to represent the quality usually associated with and belonging to plaintiff's product when first made and sold by plaintiff, the product by which it made its reputation with the public. The plaintiff, therefore, is entitled to prevent its resale to the public under his trade mark."

### Expanding Symbols

THE decision in the spark plug case, referred to under the heading "Trade Marks—Second Hand," is but one of several recent judicial pronouncements recognizing the growing importance of trade marks in modern commerce.

Business men have long recognized the fact that they can not adopt or copy the trade marks of their competitors without subjecting themselves to liability in suits for trade mark infringement or unfair competition. Many do not recognize the fact, however, that where merchandise has been sold with a trade mark affixed thereto, the purchaser of the merchandise can not so use or abuse the merchandise with the trade mark affixed thereto as to destroy or injure the good will symbolized by the trade mark.

Thus, in the spark plug case referred to, the purchaser of the spark plugs could not recondition them after they had been used and then resell them with the trade mark of the original manufacturer, and in the case referred to in this column last month under the heading "Price Fixing," the United States Supreme Court held that under the Illinois Fair Trade Statute a retailer could not resell merchandise bearing the manufacturer's trade mark at prices lower than those fixed by the manufacturer.

The fundamental reason underlying these decisions is to be found in the fact that a trade mark symbolizes the good will of the proprietor, and as such is a form of property. When the proprietor sells merchandise with his trade mark affixed thereto, he parts with ownership of the merchandise, but does not part with the trade mark affixed to the merchandise.

The Supreme Court, in the Illinois Fair Trade Statute decision referred to above, summed this up in the following statement:

"The ownership of the good will, we repeat, remains unchanged notwithstanding the commodity has been parted with."

When the full implications of this statement are realized by business men and legislators, rapid strides can be made towards eliminating many of the annoying unfair trade practices which exist today.

### Repair but Beware

CAN the purchaser of a patented article repair or rebuild the article without subjecting himself to liability for patent infringement?

This question is by no means free from difficulty. However, the law may be briefly summed up as follows: The purchaser of a patented article may make all reasonable repairs to maintain the article in good condition during its normal life. He can not, however, substantially rebuild or reconstruct the article so that in effect a new article is substituted for the original one.

It is obvious that difficulty arises from time to time in distinguishing between reasonable repair, on the one hand, and substantial reconstruction, on the other hand. In the spark plug case referred to under the heading "Trade Marks—Second Hand," the plaintiff, who was a prominent manufacturer of spark plugs, was the owner of a patent under which the spark plugs in question were manufactured. The defendant purchased used spark plugs whose efficiency had been impaired but whose usefulness had not been completely exhausted, and then reconditioned the used plugs and resold them. The plaintiff charged that the reconditioning constituted infringement of its patent. The court neatly summed up the question involved in the following statement:

"Whether the acts of the defendant here complained of amount to an infringement of any patent of the plaintiff depends upon the question of whether such acts constitute a reconstruction of the spark plug involved or merely a repair of such spark plugs."

The conclusion was then reached by the court that since the reconditioning took place during the normal life of the spark plugs and since no additions were made to the spark plugs, defendant's acts merely amounted to a reasonable repair and did not constitute patent infringement. In reaching this conclusion the court stated:

"In view, however, of the facts already stated as hereinbefore found, I can not avoid the conclusion that the defendant has merely exercised the right which, in my opinion, he had to make what are in substance and effect repairs to these spark plugs and, therefore, that he has not thereby infringed any patent of the plaintiff."

A typical case of reconstruction amounting to patent infringement is found in another case decided by the Federal Courts in which the owner of a patent for an incubator sued the purchaser of one of the patented incubators for enlarging the incubator so as to increase its capacity. In that case the court found that the alteration of the incubator so as to increase its capacity amounted to reconstruction and so changed the original nature of the device as to constitute patent infringement.

### In Union There is — ?

REFRAIN, if you wish, from selling your merchandise to any customer or to any group of customers for any reason whatsoever, but in so doing be sure that you do not combine with others in your refusal to sell.

The Federal Trade Commission recently proceeded against a group of prominent magazine publishers, alleging that they had combined together in a refusal to sell their magazines to retail magazine dealers who handled second-hand or back-number magazines. It was alleged by the Commission that the concerted refusal to sell to the dealers was for the purpose of inducing the dealers to stop selling second-hand magazines. An order to cease and desist the alleged concerted and combined actions of the publishers was issued by the Federal Trade Commission against the publishers.

From this order an appeal was taken to the Circuit Court of Appeals for the Second Circuit, and the Court affirmed the order of the Commission, holding that the combined action of the publishers amounted to an unfair method of competition. In its decision the Court stated:

"Though any one publisher acting alone may sell or not sell his magazines as he may choose * * *, two or more may not combine in such refusal if the result is to harm the public or any person against whom the concerted action is taken."

# Books SELECTED BY THE EDITORS

PHYSICS OF THE HOME

*By Frederick A. Osborn, Professor of Physics, University of Washington*

THIRD edition of a book which should make special appeal to Scientific American readers whose wives, daughters, and friends (and possibly themselves) need to know more about the physics of common household things. It is remarkable how fully the author has found examples of physical principles in homely articles—scales, wringers, vacuum cleaners, musical instruments, thermometers, fuels, refrigerators, water boilers, ranges, radiators, lamps and lighting, colored fabric, electrical equipment. This is a textbook written for women students of home economics, but many a man doesn't half know these things.—$3.15 postpaid.—*A. G. I.*

THE CHEMISTRY OF RUBBER

*By H. Freundlich, University College, London*

A COMPACT and practical pocket-size book for the chemist who is in any way interested in rubber and its uses.—$1.35 postpaid.—*F. D. M.*

AIRCRAFT AND THE AIR

*By Eric Sargent*

ODD in shape, unusual in make-up, yet comprehensive in its scope, this book gives the reader a veritable mine of information on aircraft and their present day use. The book is 5¾ inches long by 4¼ inches high, opening the long way. It gives dozens of sketches of airplanes and dirigibles together with descriptive text, and includes a number of maps of airports and airplanes. These maps are folded inserts that open to useable size.—$3.15 postpaid.—*A. P. P.*

YACHT DESIGNING AND PLANNING

*By Howard I. Chapelle*

IF YOU have had the urge to lay down the lines of a cruiser or any type of sailing yacht, yet lacked definite knowledge of how to go ahead, you may be sure that this author wrote his book especially for you. It is an amateur's book and, starting with a draftsman's thumbtack, it tacks along through "other tools and materials," "learning to plot lines," "planning the interior layout," "designing the sail plan," "working out the specifications for your builder," and finally comes into harbor with some practical appendices. It is long on common sense, short on abstruse calculations of "metastatic heights," "centers of effort" and all other reefs on which many a landlubber snags his bottom and founders. (Our nautical language was learned on an upstate frog farm.)—$3.95 postpaid.—*A. G. I.*

OUR NATURAL RESOURCES AND THEIR CONSERVATION

*Edited by A. E. Parkins and J. R. Whitaker*

UNCLE SAM has long been criticized as a wastrel. Having enormous resources originally, he has used them with profligate disregard for the future. A stock-taking is in order, and these two editors have done an excellent job of it. Besides their own contributions, they have included in their thick volume articles by 22 other experts in various fields concerned with the use and conservation of our national resources. Taken as a whole, this is an excellent constructive criticism of our way of doing things in the past, and it offers plans for a better way in the future.—$5.20 postpaid.—*F. D. M.*

THE HAY SYSTEM OF CHILD DEVELOPMENT

*By William Howard Hay, M. D. and Esther L. Smith*

STARTING with "Initial Requisites in Preparation for Family," the present book carries through the physiology of reproduction, pre-natal care, confinement, and the mental and physical requirements of children from birth to the 12th year. The text covers rather completely the subjects of food, clothing, and physical and mental development. The arrangement of the material is ideal for either straightforward reading or for use as reference. 232 pages with an excellent index.—$2.15 postpaid.—*A. P. P.*

COSMETIC DERMATOLOGY

*By Herman Goodman, B. S., M. D.*

A WIDELY known New York dermatologist presents in this robust volume a rare collection of formulas for remedial cosmetics which he has been gathering and trying out for many years. It is one thing for a book compiler, who may himself have little background, to "collect" formulas, leaving the owner of the book to work out which particular ones were worthy of inclusion, but another for a physician who has a full knowledge of the skin and its functions, experience as a physician and dermatologist, and practical knowledge of the effects of various substances, to put together a book like this. Yet both types of books look the same. Here is the general scope: acne, antiseptics, astringents, baldness, bleach, burns, cleansing cream, cold cream, corns, depilatory, face powder and rouge (now we know what's in it), lice, lipstick (it seems the base is simply beeswax—another deep secret out, showing why it sticks so well where it is supposed to be, and better still where it isn't), nail preparations, ringworm (athlete's foot), shaving (formulas for beard softeners, brushless shaves, shaving creams). This list covers but a few of the 54 chapter heads. While the drug trade will obviously use this book to best advantage, many others are equipped to make up these formulas. The book, though compact (575 pages), represents a vast amount of work.—$6.75 postpaid.—*A. G. I.*

MILITARISM IN JAPAN

*By Kenneth W. Colegrove*

EXISTENCE of a military caste and a definite military tradition in Japan sets that nation apart from the family of nations which we of the western world can more readily understand. This author, a keen observer of affairs in the Far East, who has a corps of other experts on which to lean, reveals the facts concerning the present political setup in Japan in a clear and concise manner. His book is bolstered up with a long series of notes referring to newspaper and magazine articles that are pertinent.—$.85 postpaid.—*F. D. M.*

THE BIOLOGICAL CONTROL OF INSECTS

*By Harvey L. Sweetman, Assistant Professor of Entomology, Massachusetts State College*

A SCIENTIFIC treatise on the unusually interesting art of getting rid of insects and other unwanted animals by means of other insects, bacteria, viruses and parasites "that on them prey." "The intention is to acquaint the reader with the life history, habits, methods of handling, and methods of utilization of the organisms that might be, or are be-

ing, used in controlling insect pests." This is the text book used in the graduate course on "Enemies of Insects" at the famous "Massachusetts Ag" College, and its emphasis is on thoroughness and on the practical. There is also a chapter on the biological control of pest plants. It has 420 text pages, 142 illustrations and is attractively printed and bound.—$3.95 postpaid.—*A. G. I.*

### CARBON DIOXIDE

*By Elton L. Quinn, Professor of Chemistry, University of Utah and Charles L. Jones, Formerly Chief Engineer, American Dry Ice Corporation*

CARBON dioxide in nature; its physical and chemical properties; carbon dioxide and vital processes; commercial manufacture of liquid and solid carbon dioxide; the uses of commercial carbon dioxide—these form the scope of this book which is, of course, a technical work.—$7.70 postpaid.—*A. G. I.*

### MAKE A JOB FOR YOURSELF

*By Pauline Cleaver*

WHILE the author does not set out to tell you "how to make a million," she does give a comprehensive survey of the many ways in which the unemployed can turn their hands to gainful work on their own initiative. The suggestions given—and many of them are quite detailed—range from making lampshades for sale, through such things as odds and ends markets and dog washing to setting up in "the professional handy-man" business. The suggestions have the merit of workability; time-tried methods, not theories.—$2.15 postpaid.—*A. P. P.*

### THE LIFE AND CONVICTIONS OF WILLIAM SYDNEY THAYER, PHYSICIAN

*By Edith Gittings Reid*

THE subject of this very readable biographical account was professor of medicine at the Johns Hopkins Hospital and a famous physician.—$2.65 postpaid.—*A. G. I.*

### PAY DIRT

*By Glenn Chesney Quiett*

"THAR'S *still* gold in them thar hills." It has remained for Mr. Quiett to dig it out—in the form of a collection of anecdotes and stories concerning the American gold rushes. His book is a colorful story of romantic and stirring days in American history and as such may be called an epic of American frontier days. The glamour and wealth, poverty and tragedy of miners and mining towns are discussed in carefully documented detail. Vivid personalities of those old days, such as Wild Bill Hickok, Calamity Jane, and others, are brought to life and roam again through the gold fields, gambling, cursing, and shooting as they go. It includes details of gold rushes as late as 1935 in Canada and ends with a sizeable bibliography.—$4.70 postpaid.—*F. D. M.*

### UNVEILING THE UNIVERSE

*By Norton Wagner*

INTO this one volume, approximately 7 by 10 by ½ inches, the author, a Scranton amateur astronomer, has compressed an immense amount of elementary astronomical lore. It is a sort of popular, illustrated astronomy. The book opens like a tablet, which means you have to read it with two eyes plus two hands. However, the small, compact type is very trying on the eyes, but this undoubtedly represents a compromise, for such a book, if published in the conventional way, would cost about four dollars instead of $1.15 postpaid.—*A. G. I.*

### FLIGHT TODAY

*By J. L. Nayler and E. Ower*

FROM the British point of view, this book sketchily covers the whole subject of its title from learning to fly through a description of various types of planes and why they fly, to balloons, dirigibles, Autogiros, and other types of aircraft. An appendix lists a few of the famous flights from 1783 to the end of 1935. The book is essentially popular in treatment and gives an excellent insight into the subject.—$2.15 postpaid. —*A. P. P.*

### HANDBOOK OF CHEMISTRY AND PHYSICS

*Charles D. Hodgman, Associate Professor of Physics at Case School of Applied Science, Editor*

TWENTY-ONE editions of this widely known pocketbook have been published since it first appeared in 1914. It now has 1993 text pages of chemical and physical data in condensed form, mainly as tables. No laboratory finds it easy to get along without it, and most chemists and physicists have it at their right elbow. This is their "Bible;" in fact, it resembles a Bible in outward appearance.—$6.25 postpaid.—*A. G. I.*

### HIGH-SPEED DIESEL ENGINES

*By L. H. Morrison*

SO many books on Diesels have been produced recently that our first inclination was to remark, "What! Another Diesel book?" However, it is significant that these books have been published coincident with two important things: the 40th anniversary of the first Diesel engine; and, secondly, the boom period in American Diesel practice which promises tremendous expansion in the use of this power in the near future. This newest contribution is a practical text on high-speed Diesels, including instruction on fuel-injection and combustion systems, frames and cylinders, running gear, and construction details of the different models of Diesel engines and their applications to industry and transportation.—$2.65 postpaid.—*F. D. M.*

### THE PHYSICAL BASIS OF THINGS

*By John A. Eldridge, Professor of Physics, University of Iowa*

WITH apology we review a book that is two years old; for some reason, it was overlooked but is regarded as especially worthy. This is a textbook of the modern type written primarily not for the physics specialist but for the student of general interests—though it is not elementary but assumes a good knowledge of general physics. It is thought that this treatment of modern physics will exactly meet the needs of many of our readers who wish to study a fairly serious book yet one which is not wholly mathematical.—$3.95 postpaid.—*A. G. I.*

### TELEVISION

*By Sydney A. Moseley and Herbert McKay*

HERE is another new book on television that covers adequately the fundamentals of the various types of scanning, tells what has been accomplished in the field of practical television and, in general, brings the reader up to date in the art. Although the book is written from the British point of view and consequently deals particularly with television in England, it will interest any one concerned with the developments of the present day.—$2.15 postpaid.—*A. P. P.*

### PASCAL, THE LIFE OF GENIUS

*By Morris Bishop*

WHEN but 16 years of age, the young genius Pascal established his fame as a mathematician. Though his name appears often in scientific writings, his greatest note was as a theologian. Professor Bishop of Cornell has given us a lively and charming account of his life as a boy prodigy, inventor, convert, physicist, mathematician, man-of-the-world, lover, mystic, penitent, polemist, philosopher, saint, and man.—$3.65 postpaid.—*A. G. I.*

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NINETY-THIRD YEAR • ORSON D. MUNN, Editor


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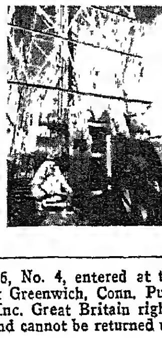

MOLYBDENUM, familiarly known as "moly," is one of the latest and most important allies of the metallurgist. The story of its development and diversified applications is told in the article starting on page 230 of this issue. Our cover illustration shows a part of the equipment used in modern oil-well drilling wherein the shafts, subjected to severe service over long periods of time, are made of a moly-alloyed steel.


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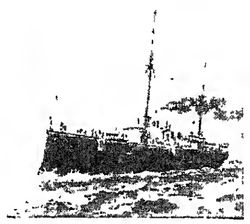
# 50 YEARS AGO IN . . .

# SCIENTIFIC AMERICAN

*(Condensed From Issues of April, 1887)*

H. M. S. "MERSEY"—"This ship, built at the Royal Dockyard, Chatham, is the first of a new class of 'protected corvettes,' strongly armed, to act as swift cruisers, and presents some structural characteristics which entitle her to be regarded as an innovation in admiralty ship building in England. . . . All the vital parts of the vessel —engines, boilers, magazines, and steering apparatus—are inclosed within a steel hexagonal hull, the plates varying from two to three inches in thickness. . . . Her armament, including two 8 inch and ten 6 inch breechloading guns, torpedoes, and ram would make her a formidable opponent for any unarmored ship. . . . Her engines, of the horizontal compound pattern, are of 6,000 indicated horse power. She is provided with twin screw propellers, and her speed will be 18 to 19 knots. . . . The principal dimensions of the ship are; Length between perpendiculars, 300 feet; extreme breadth, 46 feet; mean draught of water, 17 feet 9 inches; load draught amidships, 19 feet; load displacement, 3,600 tons. Her crew will number 300 officers and men."



CAR LIGHTING—"The regular Boston 'special,' on the Boston and Albany Railroad, was, last week, lighted by electricity and heated by steam—an arrangement which adds much to the comfort of passengers and removes altogether the danger from fire, always imminent in trains lighted and heated in the old way. . . . In every car there are twenty incandescent lamps, each of sixteen candle power, this being equal in intensity to a five foot gas burner. As these lights glow in a vacuum without combustion, there is no danger of their setting anything afire in case of accident. Indeed, the entrance of oxygen through the breaking of a globe puts an instant end to the life of the lamp."

DESERT BLOOM—"Respecting the plan of Colonel Landas for fertilizing the African desert by means of wells, Sir R. Lambert Playfair, in the course of a consular tour in Tunis, has visited the ground where the first well was sunk, and reports most favorably as to the success of the project. A space of 375 acres has been cleared, and sown with cereals and lucerne, a vegetable garden been made, and a nursery of young trees planted."

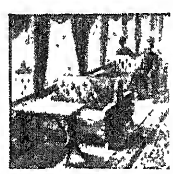
SUEZ—". . . No steamer is allowed to start on a night transit (of the Suez Canal) that is not fitted with an 'electric projector' which is capable of throwing a light for at least 1,200 meters ahead. And on the upper deck, too, there must be an electric lamp and shade powerful enough to light a circular area some 600 meters in circumference. Big steamers are beginning to carry this apparatus, but there is a company both at Port Said and Port Tewfik which lets out the necessary projectors and lamps on hire."

PROJECTILES—"The first lot of 12 inch chrome steel armor-piercing projectiles, manufactured by Messrs. Holtzer, have been received at Woolwich, and the trial took place on March 26, at Shoeburyness. Two selected projectiles were fired at 16 inch compound armor plates, manufactured by Sir John Brown & Co., Limited, and these passed through the targets, being found entire at the back. The plates were exceedingly good, being some of the hardest made by Messrs. Brown & Co., but the shells completely shattered them. This settles the question as to the value of these projectiles in the destruction of armor-plated vessels."

BOOK COVERS—"Another application has been found for metal, which is now being substituted for cardboard in bookbinding. . . . The metal is, of course, covered with the leather usually employed in bookbinding and the finished book presents no difference in appearance except in the greater thinness of the cover."

OTTO ENGINE PATENT—"The Gas-motoren-fabrik Deutz, of Deutz, Germany, who own the 'Otto' patents in Germany, and have attracted attention by the large sizes of Otto engines furnished to city water works and electric light stations, have just obtained a decision in their favor in their suit against Moritz Hille, of Dresden, a manufacturer, and several of his clients and users of infringing engines."

TABLE—"This extension or folding table is . . . designed to fold partly against and partly within a hollow side wall of a car. The wall of the car next the floor is made hollow to provide an inner space, at the top of which is journaled a roller, over which the flexible part of the table top passes. The top consists of slats glued to a flexible backing. The outer portion of the table comprises a shelf fixed to an ornamental leg provided with a ring or knob for drawing the table out fully into position for use. On the bottom of the leg are a roller and a couple of pins, which do not touch the floor when the leg rests on the roller; but when the table is drawn out the roller enters a recess, and the pins drop into holes in the floor."



NEEDED INVENTION—". . . A fortune awaits the inventor of a successful perfect dash or buggy lamp, or a lamp to be attached to a horse's breast. One that will not go out when most needed, and with sufficiently strong reflector to light the road for some distance ahead of the horse."

ASBESTOS PAPER—"Mr. Ladewig has devised a process of manufacturing from asbestos fiber a pulp and a paper that resist the action of fire and water, that absorb no moisture, and the former of which (the pulp) may be used as a stuffing and for the joints of engines."

GAS HEAT—"In applying his skill to the heating of railway carriages, Mr. William Foulis, M. Inst. C. E., the manager in chief to the Glasgow Corporation Gas Commissioners . . . (brought) the heat that is developed in the roof of the carriage while the gas is alight down to the floor of the compartment, so as thereby to keep the feet of the passengers comfortably warm, and the whole atmosphere of the compartment at an agreeable temperature."

AND NOW FOR THE FUTURE

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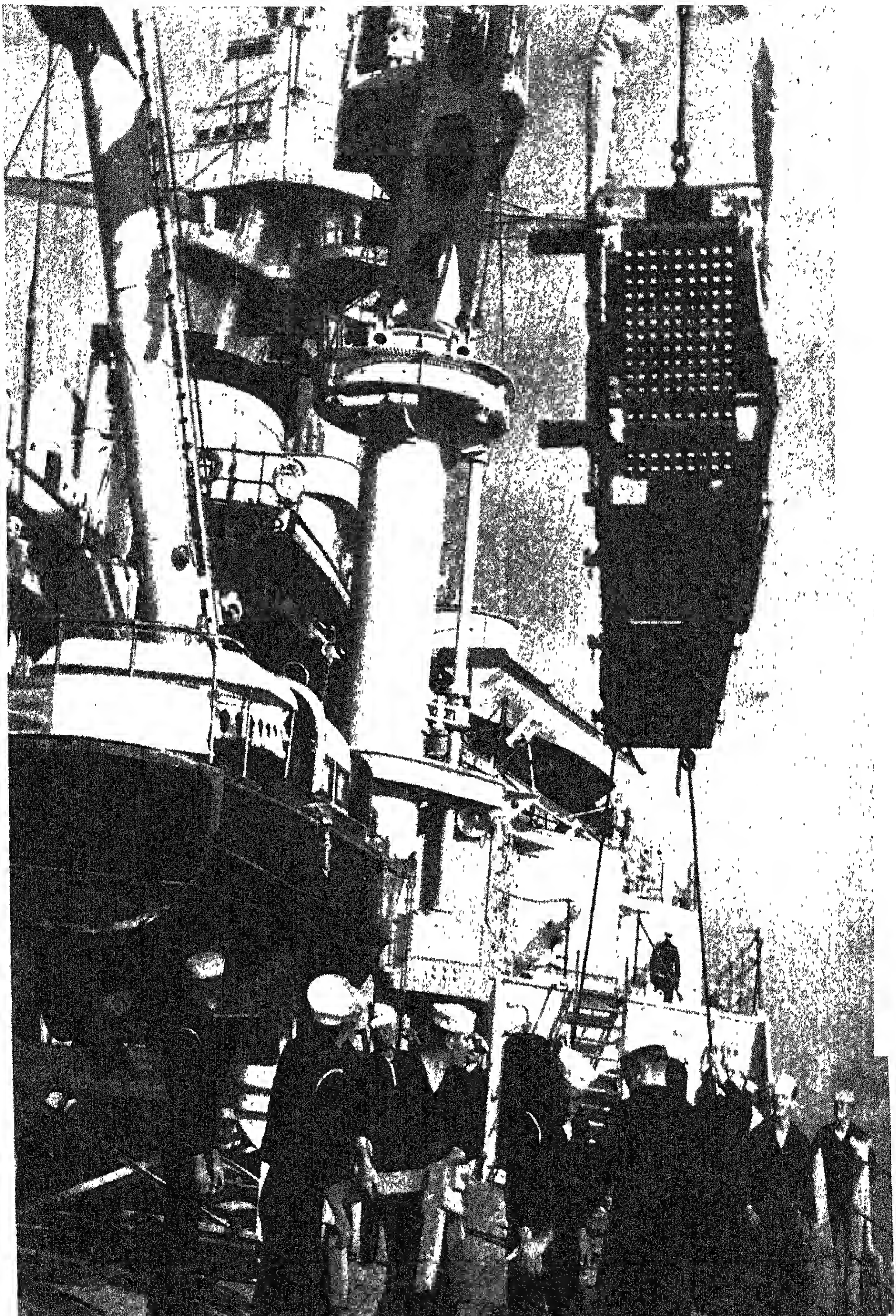
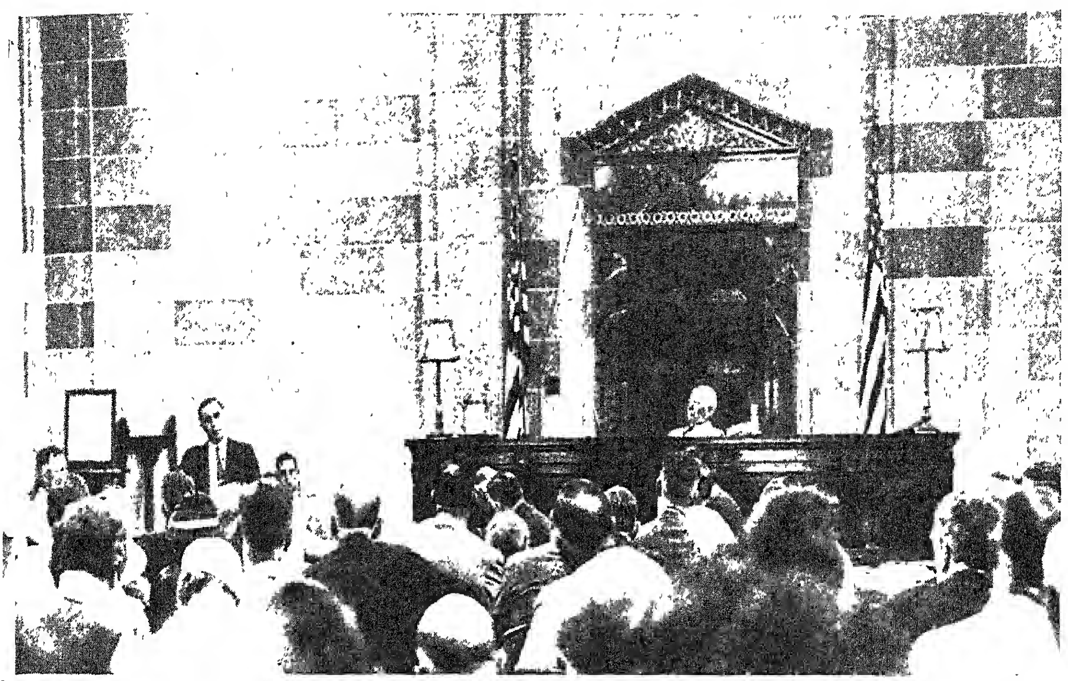
- Excavations in "The Promised Land" of Western Asia, by Jotham Johnson



**RIGGING OUT THE STARBOARD GANGWAY**

APPROACHING San Pedro, the flagship U.S.S. *Pennsylvania* is made ready for landing parties. This splendid U. S. Navy official photograph shows clearly some of the complicated deck structures of one of our finest "battle-wagons," as battleships are often affectionately called. The absence of the now outmoded basket mast is particularly noticeable.



# IMMUNITY FOR THE WITNESS

## Immunology, a Science which Often Goes to Law . . . Identifying Blood Stains . . . Animal or Human? . . . What the Bio-chemist Does in the Laboratory

By CLENNIE E. BAILEY
Department of Zoology, The University of Denver

NO doubt practically every one, in his or her life, has at one time sat in a court room during a murder trial and listened to a chemist testify that he had identified blood spots associated with the crime. Such testimony concerning positive species identification of blood spots is in reality an account of tests based on the phenomenon of immunity.

To most of us the science of immunology is associated only with serums and vaccines, infections, and epidemics. As a matter of fact it is more far-reaching in its applications than warding off disease; it not only plays an important rôle in the field of preventive medicine but it also comes into the court room and, in the witness chair, often furnishes evidence which helps to free or convict the accused.

In this latter rôle it identifies species of blood spots, ferrets out meat adulterations, fixes guilt on rapists and, in its newest function, sometimes straightens out tangled parentage situations.

It might well be asked how such widely diverging applications can be based on one branch of science. The answer to this question lies in the fact that the principle which underlies immunity is the same no matter whether it is preventing diphtheria from developing in a child or whether it is identifying species of blood stains. The working unit of this principle is a peculiar type of biological chemical known as *antibodies*. They enter into both the disease-preventing and the medico-legal rôles.

Consider an actual case in the latter field: Two men went hunting and one of them was killed. The survivor told a tale of finding the body of his partner under circumstances which suggested accidental shooting. A reconstruction of the tragedy seemed to fit his story but the widow was not satisfied with the evidence presented and demanded an investigation.

DURING the inquest the suspect was questioned about some dark brown spots on his hunting coat. He claimed they were made by blood from a deer which he had dragged into camp. For confirmation the district attorney asked a bio-chemist to identify the stains and be ready to make a report at the trial.

When the garment was turned over to the chemist he took it to his laboratory, cut out pieces containing the stains and soaked them in a salt solution. As a preliminary to his real problem he had to prove that the spots were made of blood—that is, blood from any species. This he attempted first by the use of a microscope. With this instrument he looked for red corpuscles in the salt solution. But the stains were too old—the blood cells had disintegrated. Next he looked at the solution through a spectroscope. There were the tell-tale black lines! These told him the solution contained blood. As a check he made some chemical tests and they, too, were positive. Having proved conclusively that the stains were blood, he then set about determining the species of animal from which they came. This he did through the use of antibodies mentioned above.

But antibodies—several kinds of them—have to be manufactured for this work and they cannot be produced in test tubes or bottles. They have to be manufactured in the bodies of warm-blooded animals, and this means long hours of painstaking work which goes on in the laboratory away from the court, the judges, and the jury.

The chemist carries on this tedious task in the animal room where from 25 to 50 rabbits are kept in separate cages.

*Figure 1:* Injecting serum from a given animal into a rabbit's ear. This causes the production in the rabbit's body of antibodies specific for serum of that species

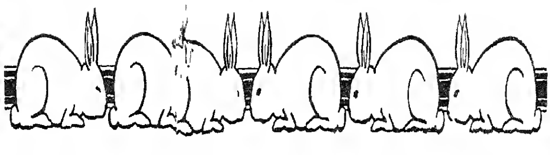
Each cage is numbered, and the chemist has already spent about three weeks immunizing the rabbits against bloods from other animal species. He has done this in anticipation of just such cases as the one he now has to work on. Rabbit Number 1 has been immunized against dog blood; rabbit Number 2 has been immunized against horse blood; rabbit Number 3 against human blood, and the others against as many kinds of blood as there have been rabbits used. (Figure 2.)

First, you will probably wonder how rabbits can be immunized against *blood*. It is like this: When a foreign material is introduced into the body of a living animal (or human) and this material stimulates the tissues of that animal to produce chemical substances known as antibodies, that animal is said to be immunized against that foreign material. When a physician, for instance, wishes to prevent his patient from contracting smallpox, he introduces the specific germs (weakened) into the body of the patient. The presence of these germs stimulates the tissues to manufacture antibodies against smallpox germs and the individual is said to be immunized. Likewise, when the chemist introduces bloods into the bodies of rabbits, their tissues begin manufacturing antibodies against the bloods, and the rabbits, too, are immunized. Each rabbit, of course, is immunized against the particular blood which was introduced into its body.

IN case of the smallpox vaccination and in the rabbit immunization, the antibodies are the working units. It is the method of using these antibodies which makes the applications of the principles of immunity appear so diverging. When human beings are immunized against germs the task is done: the body is protected because it has a vast army of antibodies floating around in its blood stream ready to kill any specific germs with which they come in contact. On the other hand, in order to make use of rabbit's antibodies, the chemist has to get them out of the animal's blood stream and into test tubes. His next step, then, is to secure some of the immunized rabbit's serum. This he does by pricking the rabbit's ear vein, collecting the blood, allowing it to clot, drawing off the serum and placing it in separate bottles, numbered according to the rabbits from which it is taken (Figure 3).

Since antibodies remain in the serum, bottle Number 1 will contain antibodies which react against dog blood; bottle Number 2, antibodies which react against horse blood, and so on down the list of animals used in the immunization process.

The serums are now ready, excepting for one more step, to be used in identifying the blood stains. It must be proved that they actually contain antibodies, a fact which cannot be determined merely by looking at them, for serum containing no antibodies at all looks exactly like that which contains a large amount.



Although all serums from the immunized rabbits have to be checked for antibodies, ten will suffice for a demonstration showing how the chemist carries out the procedure. First, he sets out ten test-tube racks and in each he places ten tubes. In the first rack of tubes he pours some anti-dog rabbit serum. In the second rack of tubes he pours anti-horse rabbit serum. Continuing in the other eight racks of tubes he pours serums as shown in Figure 4. He now has 100 tubes with ten different kinds of immune serum.

To these tubes of serum he next adds bloods. It should be noted that he does not add bloods in the same order in which he distributed the serums. This is important. To the *first tube* of each of the ten racks he adds dog blood. To the *second tube* of each rack he adds horse blood. Continuing with consecutive tubes of each rack he adds bloods from eight more animal species to the remaining 80 tubes. This order of addition is also shown in Figure 4. Thus serum from each of the immunized rabbits is mixed with blood from each animal species used in the immunizing process. The tubes are shaken thoroughly for mixing and, for a few minutes, set in a water bath at 37 degrees, Centigrade, the temperature of warm-blooded animals.

THE checking process requires a very great amount of mental concentration in order that there shall be absolute accuracy. One incorrect mixture could send an innocent person to the electric chair! But in the hands of a trained expert this never happens, and for this reason only a bio-chemist whose professional reputation has been established is allowed to prepare these tests for evidence.

When the tubes are removed from the warming bath a very striking change is seen to have taken place in some of them. This change clearly shows the significance of making the preliminary check tests. A heavy white precipitate has formed in tube Number 1 of the first rack, in tube Number 2 of the second rack and continuing consecutively to tube Number 10 of the tenth rack.

What does this prove?

It proves that immune rabbit serum contains something which, when mixed with the specific blood used in the immunizing process, causes a precipitate to form. That *something* consists of antibodies, or, more specifically, precipitins. A lack of precipitation in the other tubes proves that immune serum does not contain precipitins for the blood of animals not used in the immunizing process. In other words, anti-dog immune rabbit serum will produce a precipitate *only* when mixed with dog blood. Anti-human immune rabbit serum will produce a precipitate *only* when mixed with human blood.

WHEN the chemist took the pieces of cloth into his laboratory these specific immune serums were all ready for him to use. All he had to do was to pour a few kinds of immune serum into test tubes and mix with them some of the salt solution in which he had soaked the stains. Had a precipitate formed in the tube containing anti-deer serum it would have shown that the stains were made by deer blood. As it actually happened in this particular trial, a precipitate took place in the tube containing anti-human serum, and it was just enough evidence to send the man to the penitentiary. The records are full of similar cases.

Thus antibodies work in the field of immunity. Under the guiding hand of the physician they can become mighty *guards protecting human beings from* pestilence and plague. Under the guiding hand of the chemist they can become instruments of precision which point with deadly accuracy at stains and say: "This human being has the blood of a fellow man on his hands!"

Consider another example—one in which precipitins ferret out meat adulterations: About two years following the World War a government chemist walked into a restaurant and ordered a hamburger sandwich. At first the savory odor of onion and sauces drowned any foreign gustatory sensation he may have experienced. As he continued to masticate, however, a never-to-be-forgotten taste began to force itself upon his consciousness. Eating stew in a German prison had left him with a memory—a memory not unmixed with the flavor of a livery stable.

He got rid of his bite but put the remaining portion of the sandwich in his pocket. Later, in his laboratory, he soaked the meat in salt solution and added it to tubes of immune rabbit serum. The rabbits had previously been immunized against solutions of meats of various animal species. The precipitation tests confirmed that which his memory and taste buds had pointed out.

The restaurant owner learned, when arrested, that using canned horse meat, meant for exportation, was a source of lucrative income until precipitins caused him to pay a stiff fine or go to jail!

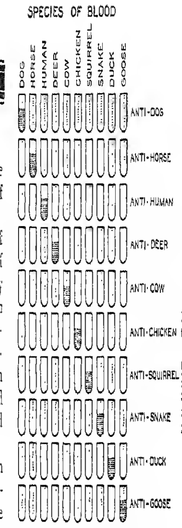



*Figure 4:* How the solution is pursued through 100 separate tests

Similarly, precipitin antibodies play a part in rape cases. Stains on clothing sometimes have to be identified as to whether they are seminal fluid. Essentially the same procedure is followed by the chemist as in identifying blood stains or meats. Anti-seminal fluid immune rabbit serum is mixed with a solution from the spot on the garment in question. If a precipitate forms in the mixture the spot had been made by seminal fluid. If no precipitate forms the evidence is in the negative. Such evidence may help to convict or free a man on trial of this kind.

IN parentage tests the procedure is also based on antibody reactions but is quite different from the types of cases described above. This kind of test involves blood groups and is too complicated to be explained in the short space allotted here. [See "Whose Baby?", by Prof. Laurence H. Snyder, Scientific American, May, 1934, pages 229-232.—*Ed.*] Suffice it to say that the test gives negative evidence (when any) instead of positive, but can be very valuable where the father of a child is disputed and where there has been an accidental exchange of babies in a maternity hospital ward.

The applications of the principles of immunity, then, depend on these unseen chemical substances, antibodies. One kind of antibody floats around in the blood stream of human beings and prevents small-pox, diphtheria, typhoid fever and many other diseases. Another kind of antibody floats around in the bodies of animals and finally comes to the witness chair and helps balance the scales of justice at courts of trial.

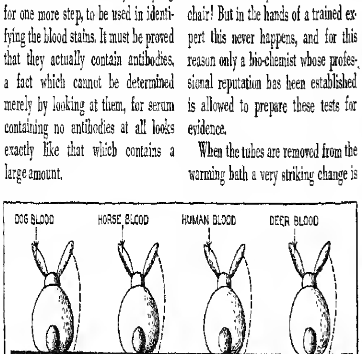



*Figure 2:* With a series of rabbits, the blood of several animals may be used, and thus each rabbit is immunized against one single, specific animal's blood

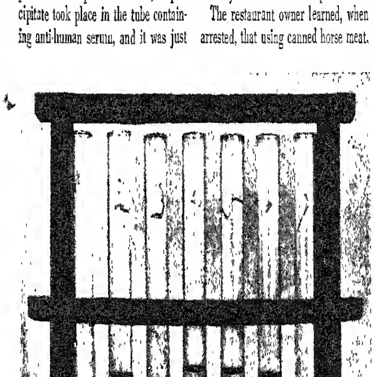


*Figure 3:* Some of the unknown blood was added to several kinds of immune rabbit serums. No. 3 alone gave a precipitate: It was from a human being

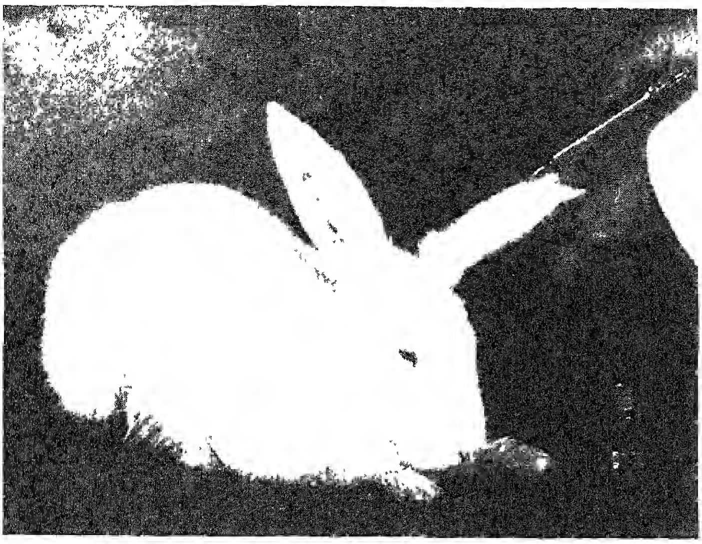


*Figure 1:* **Injecting serum from a given animal into a rabbit's ear. This causes the production in the rabbit's body of antibodies specific for serum of that species**

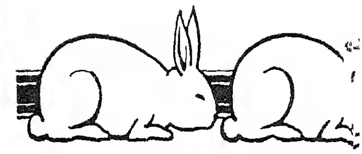
Each cage is numbered, and the chemist has already spent about three weeks immunizing the rabbits against bloods from other animal species. He has done this in anticipation of just such cases as the one he now has to work on. Rabbit Number 1 has been immunized against dog blood; rabbit Number 2 has been immunized against horse blood; rabbit Number 3 against human blood, and the others against as many kinds of blood as there have been rabbits used. (Figure 2.)

First, you will probably wonder how rabbits can be immunized against *blood*. It is like this: When a foreign material is introduced into the body of a living animal (or human) and this material stimulates the tissues of that animal to produce chemical substances known as antibodies, that animal is said to be immunized against that foreign material. When a physician, for instance, wishes to prevent his patient from contracting smallpox, he introduces the specific germs (weakened) into the body of the patient. The presence of these germs stimulates the tissues to manufacture antibodies against smallpox germs and the individual is said to be immunized. Likewise, when the chemist introduces bloods into the bodies of rabbits, their tissues begin manufacturing antibodies against the bloods, and the rabbits, too, are immunized. Each rabbit, of course, is immunized against the particular blood which was introduced into its body.

IN case of the smallpox vaccination and in the rabbit immunization, the antibodies are the working units. It is the method of using these antibodies which makes the applications of the principles of immunity appear so diverging. When human beings are immunized against germs the task is done: the body is protected because it has a vast army of antibodies floating around in its blood stream ready to kill any specific germs with which they come in contact. On the other hand, in order to make use of rabbit's antibodies, the chemist has to get them out of the animal's blood stream and into test tubes. His next step, then, is to secure some of the immunized rabbit's serum. This he does by pricking the rabbit's ear vein, collecting the blood, allowing it to clot, drawing off the serum and placing it in separate bottles, numbered according to the rabbits from which it is taken (Figure 3).

Since antibodies remain in the serum, bottle Number 1 will contain antibodies which react against dog blood; bottle Number 2, antibodies which react against horse blood, and so on down the list of animals used in the immunization process.

The serums are now ready, excepting for one more step, to be used in identifying the blood stains. It must be proved that they actually contain antibodies, a fact which cannot be determined merely by looking at them, for serum containing no antibodies at all looks exactly like that which contains a large amount.



Although all serums from the immunized rabbits have to be checked for antibodies, ten will suffice for a demonstration showing how the chemist carries out the procedure. First, he sets out ten test-tube racks and in each he places ten tubes. In the first rack of tubes he pours some anti-dog rabbit serum. In the second rack of tubes he pours anti-horse rabbit serum. Continuing in the other eight racks of tubes he pours serums as shown in Figure 4. He now has 100 tubes with ten different kinds of immune serum.

To these tubes of serum he next adds bloods. It should be noted that he does not add bloods in the same order in which he distributed the serums. This is important. To the *first tube* of each of the ten racks he adds dog blood. To the *second tube* of each rack he adds horse blood. Continuing with consecutive tubes of each rack he adds bloods from eight more animal species to the remaining 80 tubes. This order of addition is also shown in Figure 4. Thus serum from each of the immunized rabbits is mixed with blood from each animal species used in the immunizing process. The tubes are shaken thoroughly for mixing and, for a few minutes, set in a water bath at 37 degrees, Centigrade, the temperature of warm-blooded animals.

THE checking process requires a very great amount of mental concentration in order that there shall be absolute accuracy. One incorrect mixture could send an innocent person to the electric chair! But in the hands of a trained expert this never happens, and for this reason only a bio-chemist whose professional reputation has been established is allowed to prepare these tests for evidence.

When the tubes are removed from the warming bath a very striking change is

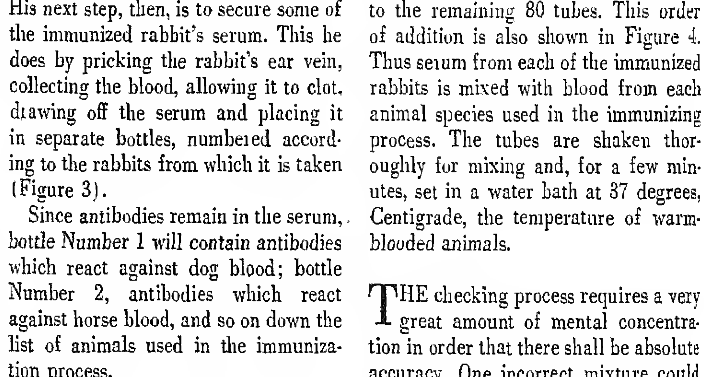



*Figure 2:* **With a series of rabbits, the blood of several animals may be used, and thus each rabbit is immunized against one single, specific animal's blood**

# OUR POINT OF VIEW

## It Can Be Done

FIRST glance at the motor vehicle accident figures for 1936 is likely to give an erroneous impression of the effect of the tremendous amount of effort that has been expended in "safety drives" in recent months. The motor vehicle accident fatality figure in 1936 jumped to 38,500 as against 37,000 in 1935, an increase of approximately 4 percent. This might seem to be an indication that the educational campaigns and safety drives have been worse than useless, but a careful consideration of the many factors involved indicates that such is not the case.

It is significant that 1000 of the 1500 increase in fatal accidents occurred during the last two months of 1936. During this same period of time it is usual for motor vehicle traffic to be reduced in volume because of inclement weather; in 1936, however, open roads and fair weather permitted heavy traffic in the northern part of the country during these two months. Then, there is the additional factor of the increased number of motor vehicles on the road throughout the year. Although traffic deaths rose 4 percent during 1936, automobile registration jumped 8 percent to a total of 28,270,000 registered motor vehicles. According to the American Petroleum Institute this record-breaking number of vehicles traveled 225,000,000,000 miles in 1936 or 22,000,000,000 miles more than in any other year.

The year 1936 saw a far greater activity in all kinds of safety promotion but it was also a period in which a larger number of vehicles traveled a larger number of miles than ever before. In spite of this, and regardless of the total increase in fatalities throughout the country, many cities and states made possible a sizable reduction in accident deaths by carrying out well rounded safety programs. Mile for mile, says the National Safety Council, American motorists operated more safely in 1936 than in 1935.

Figures show that 18 states and the District of Columbia reduced traffic deaths 7 percent in 1936, although gasoline consumption in these areas increased 10 percent. The remaining 30 states, with gas consumption up 12 percent, reported a 9 percent increase in deaths.

It is to be noted that all but two of the 18 states in which traffic deaths were reduced carried on either a complete program of safety engineering, legislation, law enforcement, education, and safety organization, or have done excellent work in one or two of these lines. Of the 30 states which showed increased death totals, more than half have not performed notable work in any important branch of traffic safety effort, although several have started.

In the face of an increasing traffic death record, it is difficult to appear optimistic. Such optimism, however, is not at all out of place as the record definitely proves that something can be done about it if only coordinated efforts adequately directed are applied to the entire motoring situation.

## Flood Curbs

HYSTERICAL thinking is always so prevalent during a major emergency that logic is submerged in a plethora of contradictions. Such was the case during the worst of the flood which overwhelmed sections of the Ohio and Mississippi Valleys in January and February. The greatest catastrophe of its kind ever to befall this country, this record-breaking sweep of turgid waters through populous cities and thousands of square miles of fertile farm lands elicited numerous impromptu plans for curbing these waters.

Just as though *now that it has come to our attention*, the government could forthwith take in hand and solve the flood problem, a friend asked the editor: "What are they going to do to prevent another such flood?" Just like that! The answer is, of course, that the problem is older than America, as such, and no one trick will presto the solution. Having fought these two wild rivers for generations—mainly by levees which offered incomplete protection—the government has, for several years, been constructing the unified, inter-linked system of protection devised in its entirety by the late Major General Edgar Jadwin. His plan, costing so far more than 300,000,000 dollars, comprises heightened and strengthened levees, emergency floodways, spillways, and "fuse plugs" which permit spreading of crest waters into catch basins. Most of this work was completed as the flood roared down from Pittsburgh but one spillway was half completed and one not yet started.

This may indicate the magnitude of the problem. It indicates also the typical fashion in which we tackle a great problem when once its seriousness overcomes our apathy. But even as General Jadwin planned it, the system of protection is not enough. Record crests at many points testify to that fact. We must take stock once more, enlarge General Jadwin's program re-plan levees, build strategic retaining dams on tributaries, heighten levees near cities, and re-forest adjacent lands to prevent too rapid run-off of rain waters. Years of hard work are ahead and hundreds of millions of dollars must be spent on the job with no certainty that it will ever be finished, no assurance that the Ohio and Mississippi will ever be completely controlled.

There is one thing that is beyond question: we *will* continue this fight. Just suppose it *is* a fight against Nature in her angriest, most destructive mood? Are we then to evacuate the two valleys, as one professor has suggested? Hardly! That is not civilized man's way. Those rivers and their ever-so-often flooded bottom lands have added billions of dollars to the wealth of the land, have provided a livelihood for many millions of people. And, anyhow, while we're abandoning these rivers to their own whims, why not abandon also most of those in this country?

## The Biologist Looks at the Motor Car

NOW that the motor car has grown up and taken on some of the mature, finished design characteristics of its middle age, the designers are on the hunt for further ways to make it a really perfect gentleman, and one of these is the small beginning already made toward the safety interior.

The car itself is made of materials which are rigid and unyielding, but what of the passengers? What is a human being but a lump of mush—protoplasm—sixty percent water and the remainder a colloidal substance dispersed in that water? What a contrast to the car itself. When you suddenly stop a rapidly moving car, so that the protoplasmic passenger, obeying the second law of Newton, continues on, his protoplasm spatters. The problem, then, is to protect mush against sudden impact.

Walk blindfolded into a door at two miles an hour and your forehead derives a nice goose-egg. Run blindfolded into it at ten miles an hour and you are knocked out. But when a car brings up against something solid at 40 miles an hour the force of the blow, by the square law, is 20 squared, or 400 times the two-mile force and you are goose-egged all over! Obviously, then, a biologist, looking at this problem, would urge that we go not a little way but as far as practicable in making the whole interior of a motor car a safety interior.

Courtesy U. S. Naval Institute—Official, U. S. Navy

# THE BATTLESHIP RETURNS

## Theoretically Obsolete a Few Years Ago, the Big Fellow is Back . . . All Powers are Building Battleships . . . New French "Dunkerque" Set the Pace

By WALTON L. ROBINSON

FRANCE has recently completed the world's newest battleship, the powerful and swift 26,500-ton *Dunkerque*. She brings to three the number of post-war battleships in service; the other two, Great Britain's mighty 33,500-ton super-dreadnoughts *Nelson* and *Rodney*, entered service in 1927. Just over a year ago, France completed one of the finest transatlantic liners in the world, the fleet *Normandie*, and now she can boast of possessing one of the fastest and most powerful warships in existence.

The *Dunkerque* was constructed as a reply to Germany's three remarkable 10,000-ton "pocket battleships." A sister ship, the *Strasbourg*, is now under construction; when ready, she will ensure France's superiority over the German vessels.

The first of Germany's trio, the *Deutschland*, was completed late in 1933; the second, the *Admiral Scheer*, in the year following; while the third, the *Admiral Graf Spee*, was commissioned for service in January, 1936.

No doubt many readers of Scientific American know of the extraordinary military qualities with which the German naval designers endowed these ships. Whereas at the time their designs were prepared other nations were constructing 10,000-ton cruisers armed with eight, nine, or ten 8-inch guns, the new German ships, on the same displacement, were to mount a main armament of six 11-inch guns. As the weight of a shell hurled by one of these is about 670 pounds as compared with the 250-pound shell of the 8-inch gun, it can be seen that a single broadside from one of the German ships would weigh 4020 pounds to the 2000, 2250, or 2500 pounds of that of a 10,000-ton "treaty" cruiser, the type built by the United States, Great Britain, Japan, France, and Italy. The German ships, moreover, were given a fair protection against shell-fire, something which many of the 10,000-ton cruisers, especially the earlier ones, sadly lack. A *Deutschland* would be able to absorb numerous hits from 8-inch shells, but a few of her 670-pound, 11-inch projectiles would suffice—if they found their mark—to send to the bottom any dashing 10,000-ton cruiser which chose to put up a fight.

Superior speed is the only advantage possessed by the 10,000-ton cruiser over the German ships. The *Deutschland* and her two sister vessels have a maximum sea speed of 26 knots. The slowest "treaty" cruisers yet built, Britain's *Kent* class, are capable of 31.5 knots, and the fastest, Italy's *Trento* and *Trieste*, are good for over 36 knots (in August, 1928, the *Trento* reached 38.7 knots).

From the above remarks it should not be difficult to understand France's consternation at the mere announcement some years ago of Germany's intention to construct a division of *Deutschlands*. The French "treaty" cruisers then built or building had the speed to bring to action one of the projected German ships, but they lacked the offensive and defensive power to defeat them. The six French dreadnoughts (battleships), on the other hand, carried a heavier armament and were more stoutly protected than the *Deutschlands*, but their low speed of only 20 knots would have made it impossible for them to bring the faster German ships within range of their powerful guns.

With her battleships too slow to catch the proposed German ships and her cruisers too weak to fight them, it was obvious that France would have to build a number of large, powerful vessels capable not only of overtaking the "pocket battleships," but also of sinking them. After studying for a number of years the best means of solving this problem, the French naval authorities at last decided on the design of the 26,500-ton *Dunkerque*.

This ship, now attached to the French battle squadron in the Atlantic, is immensely superior to any of the three German vessels. She has a designed speed of 29.5 knots, which would enable her to overtake any fleeing "pocket battleship" (officially classed as a *panzerkreuzer*, i.e., an "armored cruiser") while her powerful armament of eight 13-inch guns should make short work of one of them. At a single simultaneous discharge of all her 13-inch guns the *Dunkerque* can hurl about 9600 pounds of steel and explosives for a distance of well over 20 miles. Thus from the standpoint of offensive power alone the *Dunkerque* is more than twice as formidable as the *Deutschland*.

THE French ship's main armament is arranged in a novel manner. The eight big guns are mounted in two huge turrets, both located in the fore part of the ship, number two turret being behind and above number one. These are heavily armored and only a direct hit by a large projectile could put one of them out of action.

The secondary battery, the principal mission of which is to repel torpedo attacks by enemy destroyers, is excellent both in quantity and quality. It is composed of 16 5.1-inch guns, grouped in three quadruple and two twin gun-houses. These guns have a high angle of elevation and can also be employed against airplanes. The anti-aircraft defense proper is constituted by 12 3.9-inch guns and a number of multiple medium guns.

On the quarter deck (after deck) there are two catapults for launching into the air the four planes carried. These latter are for "spotting" purposes; that is, they will observe the fall of shot around the enemy ship, and report back to their own ship so that its gunnery officers can make the necessary range corrections. This method permits very accurate fire even at extremely long ranges.

Armor defense is very complete. Amidships, on and above the waterline, is an 8.75-inch armor belt over 300 feet in length, extending from the foremost 13-inch gun turret to the after 5.1-inch gun-house. The hull is subdivided into numerous water-tight compartments and there is a 1.5-inch longitudinal torpedo bulkhead. These elaborate underwater defense arrangements would control damage inflicted by one or more torpedo hits or mine explosions. There are three protective decks for defense against airplane bombs and plunging shell-fire when fighting at extremely long range. The upper deck has a thickness of five inches and the lower ones of three and two. The armor on the two big-gun turrets has not been divulged, but it is certainly formidable. The total weight of all this armor amounts to some 10,000 tons. Such a large percentage of displacement devoted to protection has never before been attained in a capital ship.

The designed speed of almost 30 knots is attained with engines of 100,000 horsepower. On trials the ship exceeded these speed and horsepower figures. There are six boilers. Oil fuel capacity is sufficient for an extreme cruising radius of 7500 miles at 15 knots.

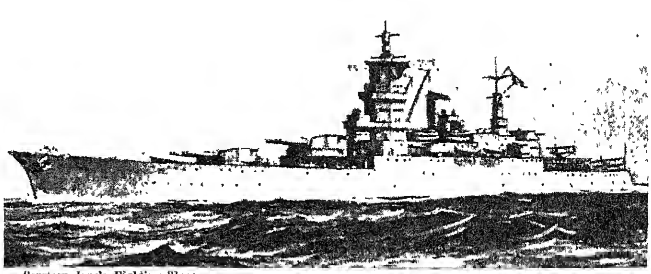
The length of this splendid ship is 686 feet on the waterline (702 feet overall) and the beam 101.75 feet. The draught is 28 feet. The ship was built in a dry dock. Being too long for the dock, the stem piece was constructed separately and attached to the hull after floating out on October 2, 1935.

As noted before, the construction of a second ship of the *Dunkerque* class, the *Strasbourg*, has been undertaken. She was laid down in November, 1934, in response to Germany's decision to continue the construction of "pocket battleships" (a year later the two supposedly "10,000-ton pocket battleships" laid down in 1934 by Germany turned out to be vessels of 26,000 tons!).

This capital ship competition between Germany and France has caused the world's leading navies to take fresh interest in the big ship and they all have begun or soon will commence the construction of new battleships to replace the old and more or less obsolete ones now in service. Just as France was obliged to lay down her two *Dunkerques* in answer to Germany's *Deutschlands*, so Italy felt the necessity to build ships capable of facing France's new 26,500-ton vessels. At first the Italian naval authorities planned units of about the same size as the *Dunkerques*, but later they decided to go France one better and build much more powerful ones. These, the *Littorio* and *Vittorio Veneto*, are now under construction and are expected to be ready in 1938. They will displace 35,000 tons, have a speed of over 30 knots, and they probably will be armed with nine 15-inch guns, mounted in triple turrets. As can easily be seen, these ships will possess almost as great an advantage over the *Dunkerques* as these do over the *Deutschlands*.

This decision on Italy's part naturally upset the French calculations and has obliged them, in turn, to make an adequate reply to the Italian ships. Consequently, in November, 1935, the French undertook the construction of the 35,000-ton battleship *Richelieu*. A similar ship, to be named *Jean Bart*, will be laid down this year. Their general characteristics are expected to be 30-knot speed and a main armament of 12 13-inch guns.

Germany, determined not to be left behind by her old enemy, decided to break the naval and military clauses of the Versailles Peace Treaty and now is building a pair of fast battleships of about the same size and speed as the *Dunkerques*. These new German ships, the *Scharnhorst* and *Gneisnau*, will probably carry nine 11-inch guns.



Courtesy *Jane's Fighting Ships*

**The French *Dunkerque* which has started new battleship building by the nations**

This extensive battleship building by European powers disturbed Great Britain. She announced, therefore, that early in 1937 she would lay the keels of two 35,000-ton dreadnoughts, the largest size permitted by the London Naval Treaty of 1936, signed by this country, Great Britain, and France. As soon as our Navy learned of Britain's decision, the Navy Department sought and obtained permission to build two ships of equal size and power. They will be commenced this year, in all likelihood.

Japan has been officially silent as regards her future battleship construction plans, but it has been rumored that

Courtesy U. S. Naval Institute
The German "pocket battleship," *Deutschland*, first of three remarkable ships

she is contemplating laying down a huge super-dreadnought of 45.000 to 50,000 tons, mounting 18-inch guns. If she should actually carry out this plan it will force the United States and Great Britain to tear up their 35,000-ton blueprint battleships and design and lay down units of the size and power of the proposed Japanese giant. This can be done without violating the afore-mentioned 1936 London Naval Treaty, for in it was included an "escalator" or "escape" clause which permits ships larger than 35,000 tons should any nation outside the treaty, as is Japan, decide to exceed that limit. Such action will inevitably lead to an unrestricted naval race between the world's three greatest naval powers, a race for superiority both in size and numbers. And the *Dunkerque*, fully described in this article, is the real forerunner of this expected naval marathon, for although Germany's *Deutschland* caused France to build the *Dunkerque*, it is not likely that such a world-wide competition would have developed so soon as it has had not France answered with her now completed ship.

OTHER nations, while marveling at the wonderful fighting qualities of the *Deutschlands*, were not worried by problems these would create for them. France, Germany's most probable opponent in a naval war, was the nation most seriously affected by the advent of the "pocket battleships." Britain had no great fear of them, nor has she now, for the Royal Navy possesses three giant battle cruisers, the *Hood, Repulse*, and *Renown*, each of which is capable of catching and blowing out of the water any of the three German ships. The other nations—United States, Japan, and Italy—are so located geographically that they have little to fear from German sea power.

Aside from the feverish new construction under way or planned, all the world's navies, large and small, which possess capital ships, have modernized them or plan to do so. These modernizations in most cases have included improved under-water protection (usually by the addition of "bulges" or "blisters" outside the hull); redistribution of armor; increase of anti-aircraft batteries; provision of "spotting" airplanes and the requisite catapult; adaptation of boilers to burn oil fuel only: and alterations in superstructure: masts, funnels, bridges, and so on.

The United States Navy has thoroughly modernized its 10 oldest battleships. Work on the remaining five has been postponed due to the unsettled international situation—just a matter of "keeping the powder dry," for a complete modernization requires withdrawing the ship from active service for from one to three years. The cost of one of these modernizations varies from about 5,000,000 to 7,000,000 dollars.

Great Britain has completely refitted all of her capital ships save her two post-war giants, *Nelson* and *Rodney*. The recent refit (1932-36) of H.M.S. *Repulse* cost in excess of 6,000,000 dollars.

Japan has thoroughly modernized at least once all nine of her capital ships, and several of them twice. Alterations to some of these ships have given them a very ugly, freakish appearance.

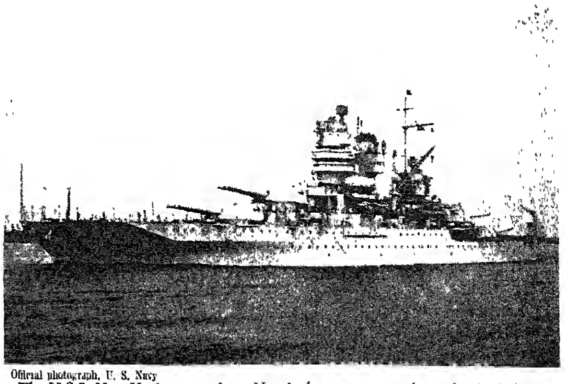
The French have periodically patched up their existing dreadnoughts. In the case of the *Lorraine*, they went so far as to remove the amidships 13.2-inch gun turret and replace it with an airplane catapult.

Italy has but four battleships completed. The two oldest of these were recently refitted. As in the case of the French *Lorraine*, the amidships turret was removed, and a catapult mounted in its place. Speed was increased from the original 22 knots to 26. It was intended to take the other two ships in hand for similar alterations, but the Ethiopian War and diplomatic difficulties with Great Britain have caused this plan to be abandoned, for the time being at least—another case of "keeping the powder dry."

Soviet Russia in recent years has been tinkering with her four much-neglected dreadnoughts, left-overs of the Czar's old Imperial Navy. Three of these ships have now been put in fairly satisfactory condition, and it is hoped to repair the fourth so that she, too, can go to sea.

THIS revival of interest in the capital ship by all the leading naval powers is especially remarkable in view of the fact that it was only a few years ago that some of them, notably France and Italy, apparently had decided to forego future battleship construction and concentrate exclusively on fast cruisers and destroyers, submarines and aircraft. It was the opinion of the naval staffs of these nations that the battleship had outlived its usefulness, that it had been made obsolete by the new inventions: the airplane and submarine, which with their bombs and torpedoes could easily sink the most powerful dreadnought. But faith in the big, heavily armored ship appears to have definitely returned. Maneuvers of all the important navies have demonstrated clearly that without battleships to fall back upon for support, even the most numerous light forces can accomplish little.

Yes, the big fellow is back—with his huge guns, his thick armor, his complement of a thousand or more highly trained officers and men, and, last but not least, his millions of dollars of initial cost and annual upkeep. Woe to the poor taxpayer the world over!



Official photograph, U. S. Navy
The U.S.S. *New Mexico*, one of our Navy's three most recently modernized ships

# THE POPULATION OF INTER

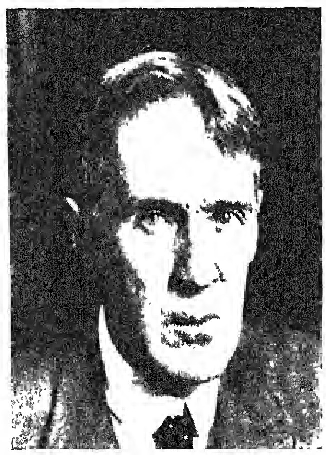
## There is Evidence that Galactic Space Contains Extremely Tenuous Material—Scattered Atoms of Gas—and is not Wholly Empty . . . Its Source?

THE vast empty spaces between the stars tempt the imagination. Here and there, scattered within them, are clouds of dust—revealed only because they hide the Milky Way behind them—and thinner clouds of gas, visible only when the light of hot stars stirs them up to shine as nebulae. But in overwhelmingly the greater part of interstellar space there is nothing that can be seen by direct observation. We know, however, that these open spaces are not altogether empty. Distant stars of the same type of spectrum appear a little redder, if they lie near the Milky Way, than if they are near its pole. There is very good reason to believe that such stars are really of the same color, and it is therefore generally admitted that there is a stratum of very tenuous material lying in the plane of the Galaxy which absorbs blue light more than red. From a star near the galactic pole, the light comes in crosswise through this layer, and the effect is very small; but when the rays come in at an oblique angle their path in the layer is longer and the star looks redder.

A very similar effect is produced in the earth's atmosphere, and stars, planets, moon, and sun look redder when they are low in the sky. Indeed, the few miles of air above our heads produce about as big an effect as the whole interstellar stratum, which must be hundreds of light-years thick.

THIS suggests that the density of matter in interstellar space may be less than that of the air in the ratio of a mile to a hundred light-years, or, roughly, as one to a million billions. But even this is too high an estimate, for it corresponds to about 25,000 molecules per cubic centimeter. Eddington showed years ago that if all the stars in the region near the sun (where we have a pretty full count) could be expanded into a uniform layer of gas, there would be only enough stuff to provide two hydrogen atoms per cubic centimeter, or a correspondingly smaller number of heavy atoms. Now the total amount of diffuse interstellar matter may be greater than that which is concentrated in the stars; but it cannot be much greater, or its attraction would affect the motions of the stars to a degree inconsistent with the facts. Hence, on the average, there can be only a very few atoms per cubic centimeter in interstellar space. If these atoms were as heavy as air molecules (which is probably an exaggeration) a layer of interstellar matter a thousand light-years thick would have to be compressed to a thickness of *one foot* in order to make it as dense as ordinary air!

The whole amount of stuff encountered in their journey through space by the light-rays of the remotest stars visible to the unaided eye is probably no greater than that which intervenes between the reader's eyes and this page. The wonder is not that space is transparent, but that so very small an amount of matter can produce any observable effects at all.



**Professor R. W. Wood, whose diffraction gratings are world-famous. In the text reference is made to his new ones made on aluminized glass**

The most powerful effect that might be anticipated is selective absorption of light—such as gives the dark lines in the solar spectrum. In an electric arc in the laboratory the outer and cooler flame, though but a fraction of an inch in thickness, often absorbs the light from the core strongly enough to produce conspicuous dark reversals of the principal spectral lines, and a corresponding number of atoms should do so in interstellar space.

Such an effect was first observed, many years ago, by Hartmann, who found in certain spectroscopic binaries that the H and K lines of calcium did not share in the periodic shifts produced by the orbital motion. They were evidently produced, not in the stars themselves, but in some cloud of gas between us and them, and far enough from them not to be perceptibly affected by their rapid motion. The fact that the "stationary" lines were narrow and sharp, while the stellar lines were broad, indicated that the medium which absorbed the former was of very low density.

Further observation has detected sharp lines of this sort in the spectra of hundreds of stars. Only two pairs of lines—until recently—have been found to behave in this way—H and K in the violet, due to ionized calcium, and the D lines of sodium in the yellow. They are observable only in hot stars, since, in the cooler ones, these same lines are produced strongly in the stars' own atmospheres, and swamp the narrow sharp "detached" lines. But they are almost invariably found in the spectrum of hot stars—except the nearest of them—and are stronger for the remoter objects. This, along with other evidence, has led to the conclusion that they are produced throughout interstellar space, which contains scattered atoms of calcium and sodium throughout its extent. The distribution appears to be somewhat patchy, but not violently so, and the strength of the "interstellar" lines may be used to give fairly good estimates of the distances of remote objects such as some recent novae.

WHY should these metals, rather than other elements, reveal themselves in this fashion? There are two necessary conditions: first, the element must be an abundant one, and second, it must have its most strongly absorbed lines in the observable part of the spectrum. This restriction cuts off the chance of finding some of the most abundant elements. Hydrogen, helium, carbon, nitrogen, and oxygen all have their strong absorptions in the remote ultra-violet, while for magnesium and silicon these are still hidden by the opacity of our atmosphere.

The action of ultra-violet starlight on the isolated interstellar atoms may be expected to ionize them, and keep most of them ionized, and this weakens our chances of finding iron and aluminum.

# STELLAR SPACE

By HENRY NORRIS RUSSELL, Ph. D.

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whose strong lines, when ionized, are at wavelengths too short for us earth-bound observers. Sodium is easily ionized, and there must be a lot of it in space to permit the D lines, which come from the neutral atoms, to be observed.

To find other elements, the search should be extended beyond the limits of every-day observation, into the deep red and the near ultra-violet. Adams and Dunham have recently done this at Mount Wilson, with notable success. Even with the 100-inch reflector to collect the light, it is not easy to get well-exposed spectra in these difficult regions; but they had a great advantage in a new grating, ruled by Professor R. W. Wood of Johns Hopkins on an aluminized glass disk and having grooves (made by the ruling diamond) of such a form that a very large fraction of the light was thrown into a single order of the spectrum. With this beautiful instrument, spectrograms of several remote stars of Classes O and B were obtained, extending into the ultra-violet beyond λ3100. These showed a multitude of rather diffuse stellar lines, and a few sharp lines of characteristic interstellar appearance. A close pair of these, at λ3303, were at once recognized as sodium lines. Like the D lines, these are absorbed by the sodium atom in its normal state; but the absorption is much weaker, and their presence increases the evidence that sodium is (relatively) abundant in interstellar space.

Two other sharp lines agreed perfectly with two of the strongest lines of ionized titanium; and two more lines of this element were detected by longer exposures. Another constituent of the interstellar gas was thus discovered. Titanium is but little harder to ionize than calcium, so we might expect that, in its case, too, most of the interstellar atoms should have lost an electron.

A very curious phenomenon now appeared. For these ionized titanium atoms the "ground-state" of smallest energy is quadruple, having four components very close together. All the observed lines correspond to absorption from the lowest of these four states. Absorption by atoms in the neighboring states, though it gives still stronger lines, both in laboratory sources and in the stars, was entirely absent.

This unprecedented behavior has been elegantly explained by Dunham. The higher components of the group which we have been accustomed to call the ground-state do not really deserve the name. They are really metastable states, like those involved in the production of the "forbidden" nebular lines.

An undisturbed atom may remain in such a state for seconds, or even minutes—an "almost infinite" time compared with a hundred-millionth of a second for an ordinary excited state. But it will not remain there indefinitely; given time enough it will spontaneously revert to some lower state, emitting the stored energy as radiation. In the very lowest state, the atom has nowhere else to go, and will remain indefinitely, until disturbed from outside.

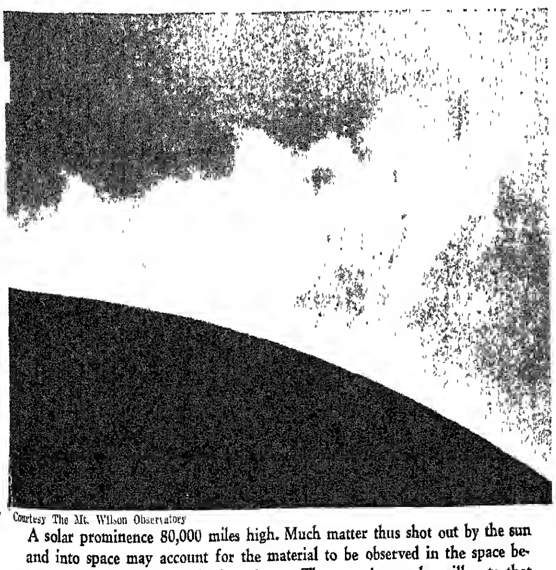
The "mean life-time" for the higher states, before such a change takes place, can be computed by quantum mechanics. Houston, for the case of titanium, finds it to be about 30 seconds.

NOW, in the exceedingly rarefied interstellar gas, collisions between atoms should be rare. Dunham calculates that the average interval should be several weeks. Other disturbances of the atom should be rarer; it would get a chance to absorb starlight less than once a century, and be hit by a cosmic ray perhaps once in a million years. If, then, the titanium atoms had, by any means, got into one of the higher energy states, they would drop back again into the lowest, or the ground-state, so soon that practically the whole of them at any time should be in this state; and only the lines absorbed from this state should appear.

The downward transition should cause the radiation of forbidden lines by the interstellar gas, but there can be no hope of observing these, for the principal one has a wavelength of 106 microns—more than a tenth of a millimeter.

This discovery clarifies the search for other interstellar lines, and improves the chance for finding them; for, instead of the complex multiplet groups which appear under ordinary circumstances, we have to look for fewer lines, which would individually be stronger. Dunham has already reported that potassium has been detected by its lines in the deep red, and other discoveries may follow. It is probable, indeed, that many, if not all, kinds of atoms are represented among the population of interstellar space.

There is no difficulty in seeing how they may have got there, if they were not "originally" present, for the actual expulsion of great masses of hydrogen and calcium from the sun has often been observed in eruptive prominences. Titanium is also found in prominences, and similar ejections from the stars may have borne a large part in keeping interstellar space from being utterly and completely empty.—*Princeton, February 5, 1937.*



Courtesy The Mt. Wilson Observatory

**A solar prominence 80,000 miles high. Much matter thus shot out by the sun and into space may account for the material to be observed in the space between the stars of our galactic universe. The attentive reader will note that Professor Russell confines his present discussion to that scope—our galaxy**

# More Efficient Locomotives

## Steam Locomotive Still Supreme . . . Fewer in Service . . . More Power . . . Greater Efficiency . . . Engineering Improvements . . . Newer Rail Power Units

By EDWARD C. SCHMIDT
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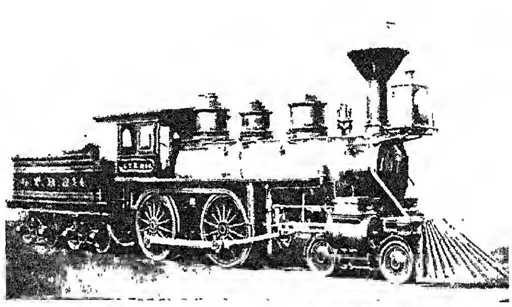
IT has taken about 110 years for the steam locomotive to develop its present effectiveness and capacity. For the first 80 years its supremacy was unchallenged; it had no rivals. With the advent of the electric locomotive and the beginnings of railway electrification 30 years ago it met its first competitor, and in the popular opinion of the day its doom was then sealed. Today less than 2 percent of the locomotives in service in the United States are electric and the limitations of railway electrification are well understood. Its more recent rivals have not impaired its position, and the steam locomotive is to-day, and is likely long to continue to be, the power mainstay of railroads the world over.

The locomotive is a traveling power plant; it must not only haul its train and provide it with light and heat and with compressed air for its brakes, but it must in addition move itself and carry its own fuel and water. These facts impose upon it serious limitations, and it is subject likewise to hampering space limitations. Because of the dimensions of bridges and tunnels its height cannot be more than about 17 feet, nor its width more than 12; its length is limited by the flexibility required to pass around curves, and cannot at present be more than about 70 feet. Its weight furthermore is limited by the strength of track and bridges and may not exceed about 35,000 pounds per wheel. It is greatly to the designers' credit that within these limitations they have succeeded in producing a machine which will develop 5500 horsepower and exert a drawbar pull of 140,000 pounds. Further comparison with stationary power plants will presently be drawn, but it is pertinent to remark here that no stationary plant can show a ratio of power to space occupied which approaches this ratio in the locomotive. It must be admitted that this output has been attained at some sacrifice of efficiency, but it is none the less remarkable. It has been attained by raising the intensity of the processes of combustion and steam production far above that which prevails in stationary plants.

The present-day locomotive produces its steam in a fire-tube boiler, uses it in reciprocating engines which exhaust it at a little above atmospheric pressure. Its combustion is maintained by exhausting the steam from its cylinders into its stack; and its cylinder power is directly transmitted to its driving wheels, and thence to its drawbar. Notwithstanding a great difference in external appearance and size, in these fundamental features of design it is like the locomotive of 1840—a fact which in the minds of those unfamiliar with its intervening history is still a matter of reproach. It is hardly necessary to add that in power, efficiency, and in general adaptation to its work it is vastly better than its 1840 prototype. It weighs to-day from 10 to 15 times as much as it weighed then; uses steam of 250 to 300 pounds pressure instead of from 70 to 100 pounds; produces a drawbar pull of from 60,000 to 140,000 pounds instead of about 5000; and can develop about 20 times as much horsepower as the locomotive of 90 years ago.



**Fundamentally, the locomotive of today, yet far inferior: an American 4-4-0 type of 1873 by Baldwin. Cylinders, 17 inches in diameter with a 24-inch stroke. Tractive effort of this locomotive was 12,600 pounds, and its weight 70,000 pounds**

This great increase in capacity has been attended by a correspondingly great increase in efficiency, so that to-day the expenditure of coal and steam per horsepower is but a fraction of what it was then. Within this interval there has been also a great improvement in details of design and in the quality of materials which have reduced maintenance costs and increased the steam locomotive's reliability and availability.

The most notable improvement has been in the use of superheated instead of saturated steam, which has decreased the steam consumption by from 20 to 25 percent, and the coal consumption almost as much. No locomotive is built today without it, and very few old ones in service have not had superheaters applied. In promoting economy, superheated steam (for the steam pressures now prevailing) does nearly all that multiple steam expansion could do, and its use is consequently responsible for the practical disappearance of compound engines in American locomotives.

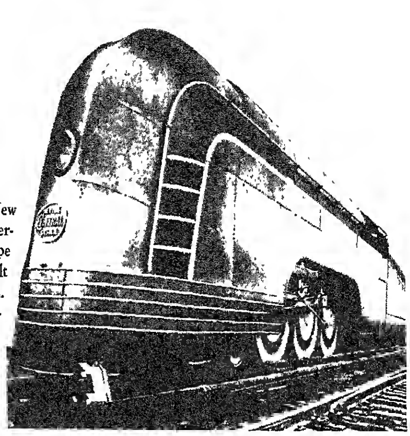
AMONG other improvements should be mentioned, the combustion chamber, the brick arch, the thermic syphon, the feedwater heater, and various improvements in the front end for producing and controlling the draft. All of these have improved the performance of the boiler by increasing its steam output or enhancing its efficiency, or both.

Economy in the use of the steam has been improved by the use of continually increasing steam pressure, and by constant improvement in valves and valve-operating mechanisms. Auxiliary or "booster" engines have been added to increase the tractive force in starting and at low speeds. As a result of this century of improvement the steam locomotive of to-day, under the best conditions, will produce one horsepower for the expenditure of 12 pounds of steam, or 1.5 pounds of coal per hour.

The performance of the locomotive is frequently compared with that of stationary power plants, although they are not really comparable. The comparison is invariably limited to a consideration of their relative thermal efficiencies, that is, the ratio of the heat equivalent of the work performed to the heat units in

the fuel consumed. In this respect, the locomotive is inferior to the stationary plant and it is likely to remain so. The implication of this comparison is, frequently, that the locomotive's efficiency could and should be brought up to that of the best stationary plants, ignoring the inescapable disadvantages imposed by the conditions under which the locomotive works, and failing to take into account capital charges and maintenance costs which must enter into any valid criterion of the economic efficiency of a plant or machine. Aside from the wide and sudden variations in load to which the locomotive is subjected, the major differences between the stationary plant and the locomotive are three: first, the former uses steam turbines instead of reciprocating engines; second, the turbines exhaust into condensers at from one to two pounds absolute pressure per square inch, whereas the locomotive's engines exhaust against a pressure of from 17 to 20 pounds, or more; and finally, the stationary plant furnishes its turbines with steam at pressures up to 750 pounds while in the locomotive pressures above 300 to 350 pounds have thus far proved impracticable, and the more common pressure is 250 pounds. All these differences operate to the disadvantage of the locomotive; its designers are well aware of that fact and attempts to obviate or escape them have occupied their attention for a generation.

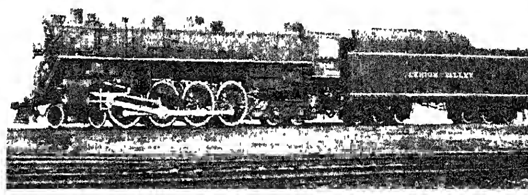
IN recent years a few attempts have been made to provide condensers for locomotives. The ordinary stationary plant condenser is a vessel containing numerous tubes which divide the condenser into a water space and a steam space, the latter communicating with the exhaust passages of the turbines or cylinders. Cold water, circulating within the tubes, condenses the surrounding steam, producing and maintaining a partial vacuum into which the used steam from the turbines or engines continues to flow. In some condensers the steam and water are directly mixed. The amount of cooling water required is very great; for a large modern plant it taxes the imagination. When, for example, the Cahokia electric generating plant which supplies power for St. Louis and its environs was first fully under way its condensers, drawing cooling water from the Mississippi River, used daily several times as much water as the daily water consumption of the city of St. Louis for all purposes. Obviously a water supply on such a scale is not available to a traveling locomotive and it would require a condenser of a different type. In the attempts which have been made to apply a condenser to locomotives the condenser is carried on a separate vehicle and consists of finely divided steam spaces cooled by a limited supply of water, which is recirculated after being itself cooled by the circulation of air induced by the movement of the locomotive, supplemented by fans. Six condensing locomotives have been built abroad. They were designed with great care and forethought, but they all proved costly and highly complicated and there is little in their performance to warrant the expectation that these disadvantages can be soon overcome, or that, except perhaps in situations where the fuel cost is unusually excessive, they can be offset by the economy in fuel. Nevertheless, a turbine-driven condensing locomotive is now under construction in this country.



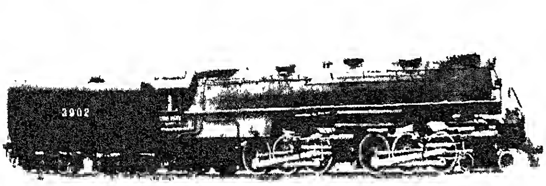
"The Mercury," a New York Central train operated by a Pacific type steam locomotive built in the road's shops. This is one of the earliest steam streamliners

Various attempts have been made on European railways to develop steam locomotives driven by turbines instead of by the usual reciprocating engines, but the resulting locomotives have either been definitely abandoned or are still in an experimental stage. The turbine has an attractively low steam consumption provided it can be kept running at its optimum uniform speed. A locomotive must, however, operate throughout a great range in speed, and if its turbine is to operate at one speed for economy's sake, the driving mechanism between turbine and driving wheels is thereby complicated—especially in view of the large amount of power required in a locomotive. Furthermore, since the turbine is not reversible, the backward motion of the locomotive must be obtained by further complication of the driving mechanism, or by the use of a separate reversing turbine.

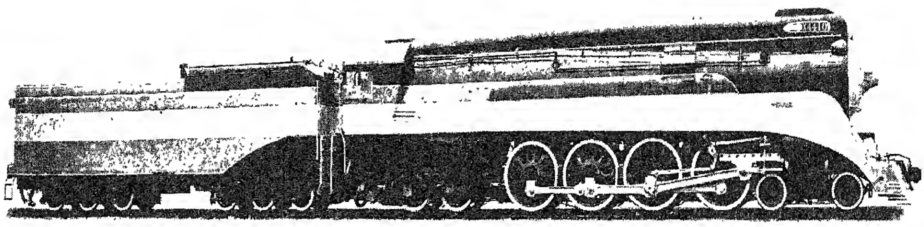
The use of higher steam pressure makes for greater economy in any steam-driven prime mover, and the standard



A typical modern engine built by the Baldwin Locomotive Works for the Lehigh Valley. Cylinders are 27 by 30 inches; steam pressure, 275 pounds; tractive force, 66,500 pounds; and weight, 435,000 pounds. Roller bearings are on the axles




A 4-6-6-4 type, articulated freight locomotive for fast mountain service built by the American Locomotive Company for the Union Pacific. Its four cylinders are 22 by 32 inches; steam pressure is 255 pounds; and it can exert a tractive force of 97,400 pounds. Its weight is 566,000 pounds; driving wheels 69 inches



One of six "largest and most powerful streamlined steam locomotives in the world" built by Lima Locomotive Works for the Southern Pacific. Top speed is expected to be 90 miles an hour. Engine and tender total 108 feet, 11 inches in length

modern power plant uses pressures as high as 750 pounds per square inch. Used in reciprocating engines, however, pressures above the usual locomotive steam pressure necessitate multiple expansion with its consequent complication in design and added cost of maintenance. A much more serious obstacle to its use in locomotives is that pressures above about 300 pounds require radical changes in the design of the standard locomotive boiler.

Beginning 12 years ago, four high-pressure locomotives have been built for the Delaware and Hudson Railroad. All four have boilers of special design; one uses steam at 350 pounds pressure, one at 400 pounds, and the latest two at 500 pounds. Three of these locomotives have compound reciprocating engines, while the fourth uses triple expansion. They are all still in use in regular service. A fifth American high-pressure engine was "Locomotive 60,000" built for experimental purposes in 1926 by the Baldwin Locomotive Works. Its boiler, of special design, generated steam at 350 pounds pressure which was used in compound cylinders. In the test plant and during road tests it gave an excellent performance and developed 4500 horsepower—the greatest power until that date recorded for any locomotive. It has since been retired from service. A few other locomotives carrying steam pressure up to 350 pounds, with boilers constructed of special steels and with some modifications in firebox design, are in service on American and Canadian roads.

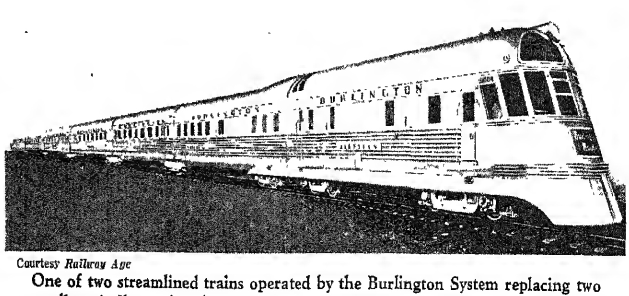
Abroad on British, German, and French railways the experiments with high-pressure steam have been more numerous and more varied. Pressures as great as 1700 pounds have been used in these experimental locomotives, which have developed high efficiencies—at the cost, however, of very expensive complication. It is significant that the German Railway Administration has definitely abandoned further experimentation with extreme high pressures and will hereafter limit its development work to locomotives with not over 350 pounds pressure—and in the majority of instances, about 300.

After years of painstaking experimentation the fundamental features of steam locomotive design remain, for the present, what they were before, with the very important exception of the use of superheated steam. Simplicity of design has prevailed over complexity, and has demonstrated that it promotes general economy and reliability, even though it entails some sacrifices of thermal efficiency. The present-day locomotive continues to have a boiler of the fire-tube type, producing superheated steam at pressures from 200 to 300 pounds, and this steam is used in reciprocating engines which exhaust to the atmosphere. In the United States and in Canada these are generally simple engines, except in some of the articulated locomotives which, having four cylinders in any case, use them as compound engines, expanding the steam in two stages. Abroad, compound engines are more common, especially in France —a fact which is to be attributed to the higher cost of fuel there, which makes even a slight additional gain in fuel economy worth the added complication.

DURING the past decade the standard steam locomotive has continued to develop, although the development has been hampered by the fact that during this period, because of the depression, fewer than the usual number of locomotives have been built. There has been a notable general increase in its capacity or tractive force. In 1925, the average tractive force of all locomotives in service in this country was 39,900 pounds; whereas in 1935 it was 48,400 pounds. This increase of about 22 percent does not fully represent the actual increase in capacity of locomotives built within the decade, for they constitute only 9 percent of the total number in service. The average tractive force of those built within the decade exceeds the average of those in service at its beginning by nearly 40 percent.

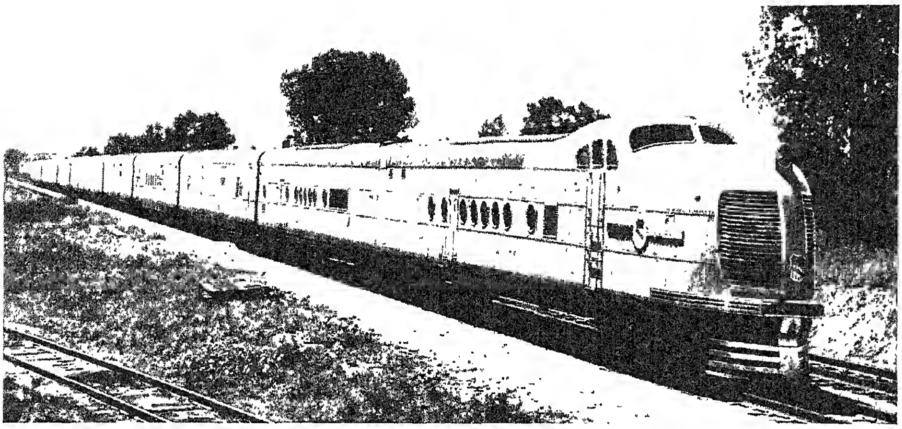
Ten years ago, the maximum recorded horsepower of any locomotive was 4500; to-day it is approximately 6500, which is the measured output of a freight locomotive built last spring by the Norfolk and Western Railway. All this has been accomplished without commensurate increase in weight, and the steady increase in capacity has been accompanied by an almost equally uniform increase in efficiency. In the freight service of Class 1 railroads of the United States, the coal used per thousand ton-miles was 140 pounds in 1925 and 120 pounds in 1935—a decrease of over 14 percent, a large share of which is attributable to greater locomotive efficiency, although it is partially due to improvement in the conditions of operation.

Within the decade there has been a general increase in the length of the locomotive's run and in its availability, which reflect the constant improvement in the details of its design. Other developments include the extension of the use of special steel alloys, particularly in the boiler and in the main rods and side rods. In the boiler they permit the use of higher steam pressure and in the rods they permit reduction in weight, thereby decreasing the difficulties of




Courtesy *Railway Age*

One of two streamlined trains operated by the Burlington System replacing two smaller, similar trains that had been operated since the spring of 1935. Each train, built by Edward G. Budd Manufacturing Company, consists of an 1800-horsepower Diesel-electric locomotive and six stainless steel passenger units



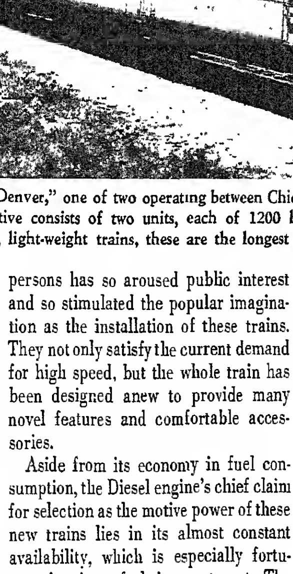
The Union Pacific Railroad's "City of Denver," one of two operating between Chicago and Denver, covering the 1048 miles in 16 hours. Its Diesel-electric locomotive consists of two units, each of 1200 horsepower; the remainder of the train comprises 10 units. Of the high-speed, light-weight trains, these are the longest and have the greatest carrying capacity

counter-balancing. Roller bearings have been applied in increasing number to recent locomotives, chiefly in the main axle bearings, but in a few instances to the main and side rod bearings. Dynamic counter-balancing is being more frequently resorted to. Poppet valves which, under certain operating conditions, improve the steam distribution are being very generally used on European railroads.

THE steam locomotive's latest rival is the Diesel locomotive, which is a locomotive equipped with multi-cylinder Diesel engines driving electric generators, the current from which is used in electric motors carried in the locomotive's trucks and connected to the axles of its driving wheels. The Diesel engine is about 40 years old; its thermal efficiency is very high (four or five times that of a steam locomotive); it is about as constantly available for service as the ordinary automobile engine; it is quiet; and it makes no smoke. Its inherent economy brought it first into use in stationary plants in places where fuel was scarce and costly, and in marine service where fuel storage space is so valuable. Its first use on the railways in the United States (in 1925) was for locomotives in switching service in situations where the appeal of its economy was reinforced by the demand for smokeless and quiet operation. More than 150 Diesel switching locomotives are now in service in this country; they range in horsepower up to 2000.

The Diesel locomotive's initial entry into main line train service came in the specially-constructed high-speed train which was put in service by the Union Pacific Railroad in 1934. This was soon followed by numerous similar trains operating at schedule speeds above 60 miles per hour and reaching actual running speeds well above 100 miles per hour. Probably nothing done by the railways within the recollection of living persons has so aroused public interest and so stimulated the popular imagination as the installation of these trains. They not only satisfy the current demand for high speed, but the whole train has been designed anew to provide many novel features and comfortable accessories.

Aside from its economy in fuel consumption, the Diesel engine's chief claim for selection as the motive power of these new trains lies in its almost constant availability, which is especially fortunate in view of their great cost. The steam locomotive must frequently be




Locomotives and their power

withdrawn from service for a few hours to have its fire cleaned out and renewed, its boiler blown down, and its machinery inspected. As far as the high speed requirement is concerned, it can be equally well met by the standard steam passenger train locomotive; indeed the standard locomotive has, in emergency, frequently run at these high speeds during the past 50 years. All it has needed is a light enough train. Of course, if it were being designed to run regularly at very high speed, certain simple changes would be made in details; the diameter of its driving wheels, for example, would be increased. It has not been difficult, therefore, for the steam locomotive to meet this new competition, and many of the recent high-speed trains are being operated with standard locomotives—modified in some details, and shrouded to decrease the air resistance; but without fundamental design changes.

THE first of the Diesel-motored high-speed trains, the Union Pacific three-car train, during a test run, attained a maximum speed of 111 miles per hour. Even before this train was put in service, however, a standard passenger steam locomotive of the Chicago, Milwaukee, St. Paul and Pacific Railroad, with a train weighing five times as much as the Union Pacific train and running in regular service from Chicago to Milwaukee, covered the intervening 86 miles at an average speed of 76 miles per hour, ran 61.4 miles of that stretch at an average of 92.6 miles per hour, and reached a maximum speed of 103.5 miles per hour—all this with an engine in regular service hauling five standard cars. New York Central locomotive No. 999, hauling the famous "Empire State Express," is reported to have attained a speed of 112.5 miles per hour over one mile of its run back in 1893. Comparably high speeds have been attained in regular service on British and French railways for many years.

Good examples of this recent adaptation of the steam locomotive for very high speed are offered by the engines which draw the New York Central Railroad's high-speed train, "The Mercury," running between Cleveland and Detroit;

(*Please turn to page* 248)

# UNSCIENTIFIC MEASUREMEN

## Are Famous Track Records Inaccurate? . . . Effects of the Earth's Gravity and Rotation . . . Even the Latitude Has Effects That Alter the Records

FOR every person who knows accurately how long it takes the earth to travel a lap of its long race around the sun a hundred individuals could probably state the best time of the reigning champion in the 400 meter run. Likewise, for one who can recite the distance from the earth to the moon it is likely that a whole frat-houseful could shout the distance of the Olympic broad jump record in chorus. This distribution of knowledge, or ignorance, is cited not to view with alarm but to emphasize the proposition that from a popular standpoint the statistics of sport occupy a position of prominence outranking those of the sciences or of scholarly studies in general. The speed of Malcolm Campbell's automobile or Jesse Owens' legs make conspicuous headlines, while a determination of the speed of light rates a small announcement on an inside page.

But when the data of sport are examined with the critical and skeptical eye which is continually focused upon the data of science, it is found that athletic measurements have not been guarded by the scrupulous precautions against error which are commonplace in the laboratory. In view of the widespread and even worshipful interest which is accorded to athletic records it seems unfortunate that they are not maintained upon as high a plane of scientific accuracy as is reasonably possible. To this end, those in charge of the technical background of sport might appropriately borrow a leaf or two from the notebook of the man of science, particularly the physicist.

Athletic administrators and instructors are, for the most part, practical persons and probably few of them feel the need of a scientific brain trust, including professors who would have trouble lifting the 56-pound weight from the floor to the lecture table. It is true that these advisers could not guarantee results in the form of new and greater track and field performances, but assuredly they could guarantee for accepted records a higher validity than some now possess. They could frown upon the practice of announcing the speed of an automobile in six or seven digits (see, for example, the 1937 "World Almanac") when neither the length of the course nor the elapsed time is known one tenth so precisely. They could and would point out such inconsistencies as that observed in some of the events of the 1932 Olympic games when races were electrically and photographically timed to 1/100 of a second but with the starting gun fired from such a position that its report could not reach the ears of the waiting runners until three or four one-hundredths of a second after the official start of the race. In this case electrical timing was used only as an unofficial or semi-official supplement to tenth-second hand timing, but it is easy to see that a systematic error of a few hundredths of a second will frequently cause stop-watch timers to catch the wrong tenth.

SCIENTIFIC counsel on the field would immediately advise judges of the high jump and pole vault to measure heights from the point of take-off instead of from an irrelevant point directly below the bar. They would suggest equipping judges of weights with surveying instruments for determining after each throw, not only how far the implement traveled but also the relative elevation of the landing point and the throwing circle. Certainly it is meaningless if not deceptive to record weight throws to a small fraction of an inch when surface irregularities may be falsifying the true merit of the performance by inches.

In shot putting, for example, a measured length will be in error by practically the same amount as the discrepancy in elevation, since the flight of the shot at its terminus is inclined at about 45 degrees to the horizontal (Figure 1). For the discus the effect is some three times as serious because of the flatter trajectory employed with this missile, while broad jumpers under usual conditions must be prepared to give or take as much as one half foot, according to the luck of the pit.

At the 1932 Olympic Games an effective device was used to grade the broad-jumping pit to the level of the take-off board before each leap, but the practice has not become general. Athletic regulations, indeed, recognize the desirability of proper leveling in all the field events, but in actual usage not enough is done about it. Since sprinters are not credited with records achieved when blown along before the wind, there is no obvious reason why weight hurlers should be permitted to throw things down hill.

The rule books make no specification as to the hardness of the surface upon which weights shall be thrown, but this property has a significant effect upon the measured ranges of the shot and hammer, since it is prescribed that measurement shall be made to the back side of the impression produced by the landing weight. In a soft surface this im-

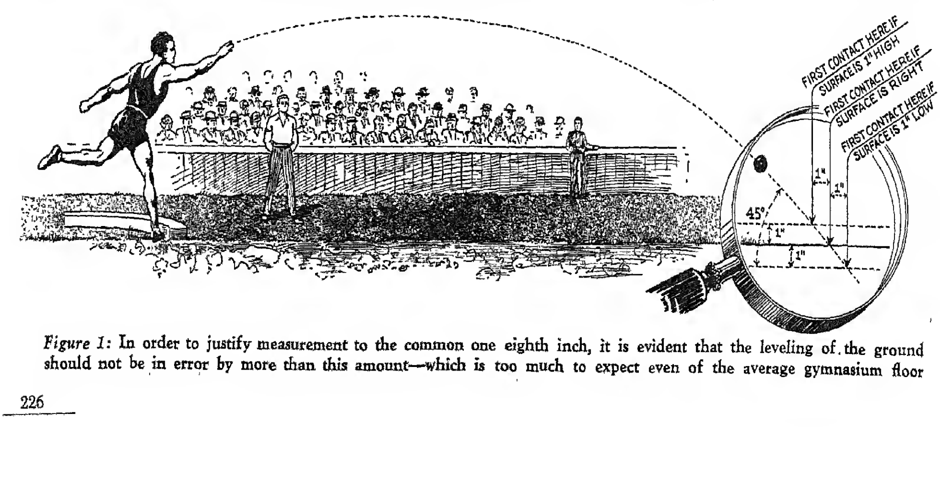



*Figure 1:* In order to justify measurement to the common one eighth inch, it is evident that the leveling of the ground should not be in error by more than this amount—which is too much to expect even of the average gymnasium floor

# IN ATHLETICS

By PAUL H. KIRKPATRICK
Associate Professor of Physics, Stanford University

pression may be enlarged in the backward direction enough to diminish the throw by several times the ostensible precision of the measurement.

AMONG the numerous errors afflicting measurements in the field sports there is none which is more systematically committed, or which could be more easily rectified, than that which pertains to the variation of the force of gravity. A hypothetical athlete with ideally machine-like form could be expected to throw a weight identical distances upon all attempts made at a given time and place, but he should *not* be expected to repeat his standard performance identically in all other parts of the world, since the weight will be heavier in some places than in others.

Every toss of a weight is a contest between the heaving athlete and the force of gravity, and the result which ensues depends jointly upon the contestants. If gravity were to give up altogether the weight would never descend, while if it were to take on the preposterous values existing on some of the stars the thrower's toes would be in danger. No such fantastic variations disturb terrestrial athletic competitions, but the well-known local variations which do exist are quite sufficient to wield a balance of power in a close contest with the record books.

The shot putter from the Finnish coast, for example, who journeys to Rome or Hong Kong for competition has every scientific reason to expect that a heave which would have yielded 50 feet at home will be good for an extra inch at the lower latitude, solely because of the diminished pull of gravity upon the thrown weight (Figure 2), and with the discus, hammer, or javelin, it will be good for more—exceeding one foot in the case of the javelin. An inch is not a great deal of extra distance but it has sometimes been enough to cause a record to change hands. It must be remembered that the "profits" in the business of athletic competition are realized only in the last percent or two of the output, the rest being in the nature of necessary overhead.

Continuing southward to the equator, but remaining at sea level, the northern athlete gains a second inch, and by climbing a mountain of middling height, still a third. These illustrations are in accordance with the simple principle of ballistics that the range is inversely proportional to the acceleration of gravity, a principle which applies with high accuracy to athletic artillery when all other conditions, including the work done on the weight by the thrower, are held constant.

Similar effects naturally occur with all the thrown weights. Hammer throwers with Olympic aspirations may take satisfaction in the award of the 1940 games to Tokyo rather than to Heslingfors, for a well-thrown hammer will go some four and a half inches farther in Japan than in Finland. However, if the Olympiad were to be located for the sole benefit of the weight records, Tokyo would not constitute an ideal selection, for, by moving southward to Java, hammer throwers would be benefited to the extent of an additional three or four inches, with other weight men profiting similarly in proportion to their respective ranges.

A jumper is also a projectile, even though he be hoist by his own petard. Broad jumps are frequently measured and recorded to the final eighth of an inch and such precision of measurement is to be commended, but in comparing the results of these measurements one should realize, as apparently one never does, that any reasonably good broad jump is three eighths of an inch broader in Texas than it would be in Massachusetts. The values of the acceleration of gravity which produce such inequalities as these are on record for practically every spot on the habitable world, so anyone who is disposed to do so can rectify the records at his pleasure.

A FURTHER geophysical phenomenon with a small but noticeable effect upon athletic performances is the rotation of the earth. Physicists and artillerists have known for a century and more that projectiles fired from the surface of the real rotating globe do odd things which could never happen if the earth were at rest. Freely falling bodies (except at the poles) do not fall parallel to the plumb line but deviate to the east as they fall. Bodies projected straight upward—that is, parallel to the plumb line—do not return to the point of origin but fall slightly to westward. The range of a projectile which is shot upward at an angle will agree with the usual elementary calculations if the experiment be performed at one of the poles, but not elsewhere except for certain selected directions of fire.

These effects have nothing to do with the drag of the air and are in addition to any consequences deriving from the fact that gravity itself depends partly upon the centrifugal forces of our rotational motion. They are due rather to the fact that the gravitational pull upon the projectile is applied in a constantly changing direction as the earth turns, and to the further fact that the landing surface does not await the arrival of the projectile in any such relative position as it occupied when firing occurred, but instead drops away from the projectile to the eastward or rises to meet it from the west, thus either extending or curtailing the measured range.

In Figure 3, for example, four riflemen are shown at the equator, on a

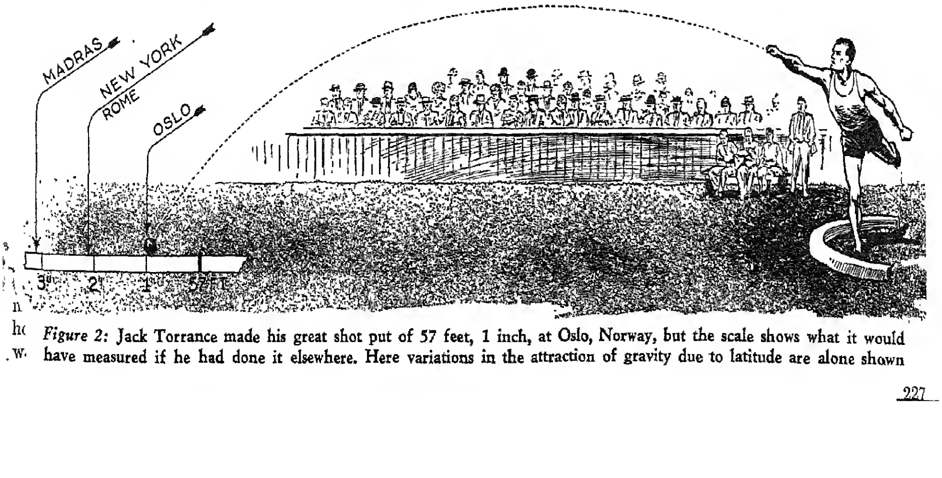



***Figure 2:*** **Jack Torrance made his great shot put of 57 feet, 1 inch, at Oslo, Norway, but the scale shows what it would have measured if he had done it elsewhere. Here variations in the attraction of gravity due to latitude are alone shown**

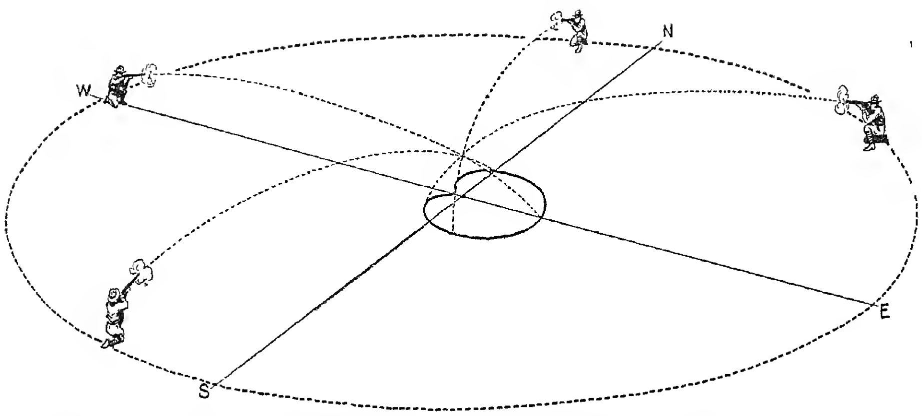



*Figure 3:* Showing the effect of gravity and rotation of the earth on the range of a projectile. An "air view" of a circle of riflemen firing with identical arms toward the center of a circle. The relative sizes of the outer and inner curve have been distorted in order to facilitate making the drawing. Actually the outer circle has a radius of about a mile and the inner one a diameter of about 60 feet—though the inner one, because of the effects of earth spin, is not actually a circle but is an interesting lop-sided figure with a dimple on one side and known to geometers as a "limacon of Pascal," as explained in the text

level plane, firing with identical arms toward the center of a circle of 1592 meters radius. If this experiment were conducted at one of the poles the projectiles would just hit the center, but at the equator the central curve shows the actual landing of the bullets, ignoring the effect of air resistance. All bullets tend to go farther at the equator than at the poles because of the lower value of the force of gravity. Thus the locus of the landing bullets would be a circle about 16 meters in diameter, except for an added complication due to the earth's rotation effect. This extends the range of east-bound bullets and diminishes that of west-bound bullets, though not affecting the range of north- or south-bound bullets because these are not affected by earth-spin and show only the normal increase of range due to low gravity. The curve is called a limacon of Pascal, and the one shown in Figure 3 is approximately correct for a bullet with initial speed of 300 meters per second, fired at a 5-degree elevation.

To correct the performance of, say, a discus thrower for the effect of the earth's motion, it is necessary to take account not only of the latitude at which the throw took place but also of the direction in which the implement moved. We read that the Olympic record for this event was set up by John Anderson at Los Angeles with a throw of 162 feet, 4⅞ inches. If we are to deal in small fractions of an inch it becomes of interest to know whether this throw was made in an easterly direction, thus gaining half an inch through the assistance of the earth's motion, or to westward, giving away a like amount. Since it has never been customary to record this information it is hardly practicable to make the small adjustments of past performances with the hammer, javelin, and discus which are logically indicated in consequence of terrestrial rotation.

THE effects of gravity and rotation introduce no unfairness into a competition as ordinarily conducted at a given location, but when achievements from one place are compared with those from another (Figure 4) the effect is to impose handicaps upon the performers who were obliged to strive against the larger gravity or the more adverse rotational influence.

In all cases where adequate data are at hand the method of redress is by simple arithmetic, in conjunction with two or three venerable formulas which are commended to the attention of coaches, athletes, and diplomats of sport.

The labors of Newton and Copernicus have been complete for some time now, but news sometimes seems to travel slowly in precisely those quarters where it is significant.

To some the contentions raised above will seem hair-splitting, and such indeed they are. The splitting of hairs has ever been an essential part of the technique of accurate measurement, without which the measurer runs serious risk of misleading himself as well as others. If the ultimate eighth of an inch of John Doe's hammer throw or broad jump is to be entered in the records at all, it would seem sensible to try to get it down correctly. In case this seems to be too much trouble, it would be both honest and informative to adopt for sporting data the standard scientific practice of accompanying the recorded measurement by a kind of shorthand clew indicating the extent to which it should be believed.

Apparently athletic administrators have got into the business of precise measurement without at all realizing the elaborate precautions which must be observed when anything at all is to be measured correctly to better than a tenth of one percent. It seems improper to keep up the appearances of accurate and comparable measurement in field events without striving to obtain the reality, and this can be obtained only by putting the matter on a scientific basis.

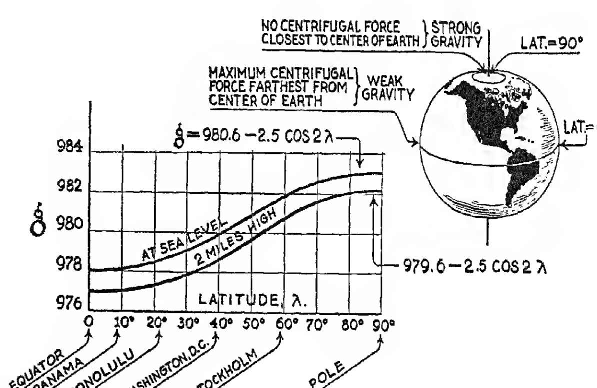



*Figure 4:* **Illustrating the variations of gravity due to differing latitude, differing elevation, or both. The symbol *g* represents the downward pull of gravity per gram of matter. The earth's amount of polar flattening is shown exaggerated**

# IMPROVED SHORE DEFENSES

## Permeable Jetties . . . Better Than Solid Ones . . . Trip Waves Without Stopping Them . . . When Water is Slowed Up, it Deposits Sand, Builds Beaches

By R. G. SKERRETT

SHORE erosion has become an acute problem along the water fronts of the Great Lakes, where the advance of the water upon the land has averaged, over a period of years, as much as four feet annually.

When Lake Michigan was exceptionally high some months ago, a series of severe summer and fall storms drove the waves violently against the exposed shores, smashing jetties, piers, breakwaters, bulkheads, and sea walls, and undermining bluffs and numerous buildings close to the water front. Millions of dollars had to be expended in making repairs and in rearing new defenses against subsequent storms.

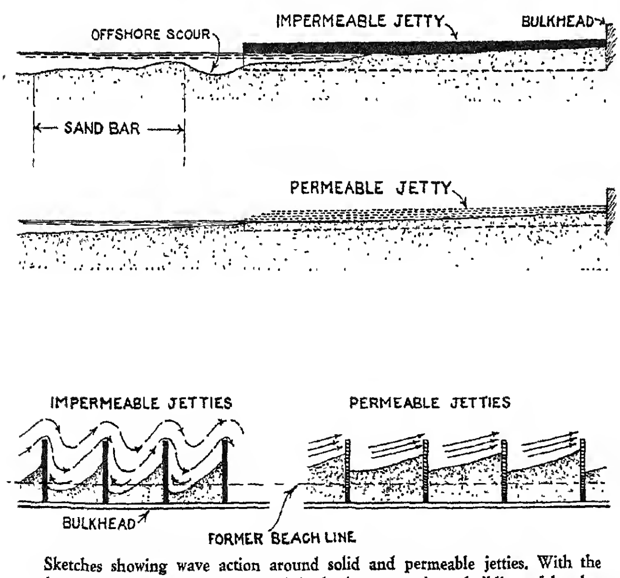
Town authorities and property owners generally, along the west shore of Lake Michigan, had previously relied upon conventional forms of man-made obstructions to withstand the assaults of pounding waves; when most of the solid jetties built out from the beaches were wrecked, there was doubt about what to do next in an effort to arrest or at least to rob the billows of most of their destructive might before breaking on the beaches or reaching the innermost of the defenses. Then it was that a new type of permeable jetty was developed and progressively improved to meet just such situations. The results have been astonishingly satisfactory.

The problem involved is twofold: First, gradually to bring about the upbuilding of a gently sloping beach that will reach farther and farther offshore so as to trip up oncoming waves by reason of an extended area of relatively shallow water, and thus sap the waves of their strength so that they have little remaining power to do damage by the time they arrive at the shoreline; and second, to induce the ordinarily erosive currents that travel parallel with the shoreline to deposit material and to extend beaches instead of cutting into them and carrying their substance away. The permeable jetty of the new design has shown that it will do both of these desired things and do them more effectually than the usual solid and abruptly obstructing kinds of jetties.

The permeable jetties recently built along the west shore of Lake Michigan rise from shallow trenches excavated in the underlying clay stratum of the beaches and extend from the shore out into sufficiently deep water to serve the purpose at each location. The jetties are composed of precast concrete bars, laid horizontally, and held together by perpendicular steel rods. The bars are arranged to form a stable and somewhat open cribwork that increases in its permeability from the shore outward and from the base upward. The unit bars weigh from 1000 pounds to 4000 pounds.

The winding passageways through the jetty allow the littoral currents to make their way through the jetty without being deflected sharply offshore, and the currents are thus slowed up just enough to cause them to precipitate on each side of the jetty some of the sand carried by them and thus to upbuild the adjoining beaches on both sides. The solid jetty, on the other hand, benefits only the windward beach and brings about reactions that usually erode the leeward beach to a more or less extensive degree. The permeable jetties on Lake Michigan have led to very remarkable results; beaches have been restored and extended in the course of a few months.

THE outer end of a permeable jetty, in the deeper water, stands directly in the path of the unbroken masses of approaching waves, but the open nature of the structure there serves to upset the rhythm of the waves without interposing a rigid obstacle. Therefore the waves are tripped and break shortly afterwards as they sweep onward. In this manner, the permeable jetty, itself, does not invite the destructive impact of the waves where a solid jetty must withstand their full force. Such being the case, it is claimed that the permeable jetty will endure in the face of conditions that would be likely to destroy a solid jetty. In short, the permeable jetty tricks storm waves and prevailing currents into serving man's ends, while the solid barrier, in effect, challenges nature's forces to do their worst without any temporizing on man's part. Experience has shown that nature in the long run is the victor. Because the permeable jetty induces beach building on each side of it, fewer jetties of that type would be needed to protect a given length of shore. Once more the inventive engineer offers an improved way of meeting a situation that menaces shore property where exposed to the repeated attacks of wind, wave, and current.



Sketches showing wave action around solid and permeable jetties. With the former there is much scouring, while the latter permits upbuilding of beaches

A whole mountain of ore where mining is almost as

# POLYGAMOUS

By PHILIP H. SMITH

MOLYBDENUM is a newcomer. It's so new its name is strange to the lay world, yet "moly," as this element is known to its intimates, serves millions of consumers every day. Better automobiles, higher grade gasoline and lubricating oils at prices one can afford. and quality radio tubes are just a few of the present-day essentials which molybdenum has made possible.

The Romans knew of moly, but its commercial debut is a matter of two decades. For centuries it was just a strange substance, frequently confused with lead sulfide because of a similar appearance in its natural state, and having no commercial reality of its own. Today, it is recognized to be an exceptional alloying metal and an element having possibilities worthy of broad exploration, but to win this recognition it had to fight its own way in a world preëmpted by metals of unchallenged worth.

Scientific research and performance under competitive fire are the two factors responsible for moly's dramatic rise. so clearly traced in world consumption which was practically negligible in 1917 and now exceeds 19,000,000 pounds annually. History links these two factors from early times. The story is told that a German metallurgist, hearing that a Japanese sword-maker, one Masamune, made a superior product about 1300 A.D., secured one of the blades and analyzed it. He announced that the presence of molybdenum, presumably as an ore contamination, gave the sword its merit. This determination, mind you, came six centuries later.

Since research had revealed by 1900 that molybdenum improved the properties of steel, why wasn't immediate use made of this finding? There is a very good explanation. In the first place, molybdenum was a relatively rare metal prior to 1918. It was also very expensive, selling at a nominal price of five dollars a pound. There were only a few scattered deposits, and the uncertainty of supply, coupled with high cost, were not conducive to commercial exploitation. The start of its meteoric rise began with the discovery of a mountain of molybdenum-bearing ore in Colorado. That was in 1917 when dislocation of raw materials and unusual demands incident to the war gave impetus to the use of new materials and new processes.

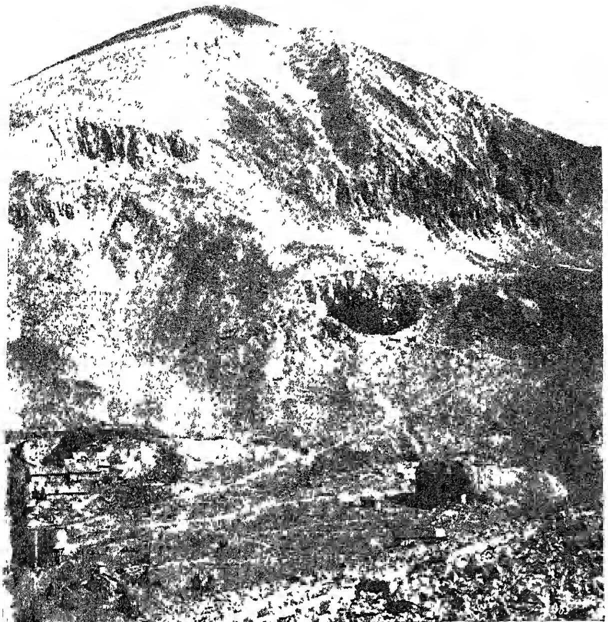
Drilling preparatory to "shooting" in one of the main headings of the huge moly mine

We can pass over this period of introduction when use was sporadic and hesitant. Few people appreciated what was coming about. Perhaps you admired the Wills-Saint Claire motor car in 1921, without knowing that it was the first all-molybdenum steel automobile. None but a metallurgist could have sensed what this car foretold for the automotive industry which was later to become a prime user of moly steels. This was the teething stage; the important thing is the place of molybdenum today and what it contributes to industry.

To the alloy age—the present—molybdenum makes two major contributions. It substitutes for certain other alloys, or combines with them, to produce better steels—better in the sense of possessing superior qualities, better by virtue of lowering costs. In certain instances it makes possible a saving in first cost and it may also produce a steel which can be fabricated at lower cost. When both savings can be had in a single alloyed steel there is a decided overall gain.

HAD the five-dollar price of 1918 been maintained, molybdenum would not be where it is today. It is the 80 cents per pound cost which makes the savings possible. Furthermore, early experiments demonstrated that it was very small amounts of molybdenum that gave the desired properties. A good average admix to steel is now one fifth of 1 percent by weight.

The improvements in fabricating prop-



rying: The world's largest moly deposit, in Colorado

# MOLYBDENUM

## Versatile Moly . . . Industrial Newcomer . . . Important for Alloying . . . Improves Physical Properties . . . Catalyst . . . Unusual Potentialities

erties which molybdenum imparts, stated as a generality, are a wider forging range without danger of burning, free. scaling, and safer wide heat treating. It also offers the distinct advantage of permitting a reduction in the amount of alloys used. This improves physical properties, for it is very well known that the more the alloy, the harder it is to work the steel. Practically all alloy steels produced commercially today have a tendency to develop temper brittleness, and the introduction of molybdenum will diminish if not eliminate this difficulty. But let us get down to cases.

Molybdenum is most widely used in automotive steels where quality and cost come up for closer scrutiny than perhaps in any industry. Ten years ago the carburized steels used for gears, for example, contained about 3.5 percent nickel. Now such steel has been very largely replaced by a nickel-molybdenum steel which contains 1.75 percent nickel and 0.25 percent molybdenum. Here a very small amount of moly has made it possible to reduce the nickel content to produce a steel which costs roughly nine dollars a ton less and has the advantages of better forging properties, free scaling, improved machineability, and less distortion upon heat treatment.

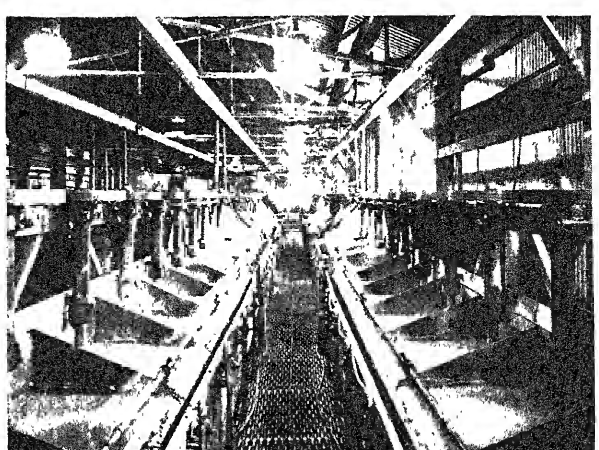
Among other automotive parts in which molybdenum plays an important rôle are axles, steering knuckles, and propeller shafts, parts which must withstand the severest service. Such units were formerly made of chrome-nickel steel—a very high grade steel alloyed with 1.25 percent nickel and 0.80 percent chromium. Today chrome-nickel is being replaced by chrome-molybdenum steel in which the chromium content remains unchanged but the nickel is wholly supplanted by 0.20 percent molybdenum. This new steel costs about one dollar per ton less and is very much like a straight carbon steel in the ease with which it can be handled. It is free scaling, can be forged easily, and machines well, even at high hardness.

Use of the chrome-molybdenum steels is not confined to automotive units. The very qualities which recommend them to America's outstanding industry qualify them for a wide variety of other applications, where ease of welding, abrasion resistance, or good service at elevated temperatures may be desired. Thus we find chrome-moly going into turbine shafts, dipper teeth, welding rod, shovels, saws, dies, castings, and other equipment in severe service.

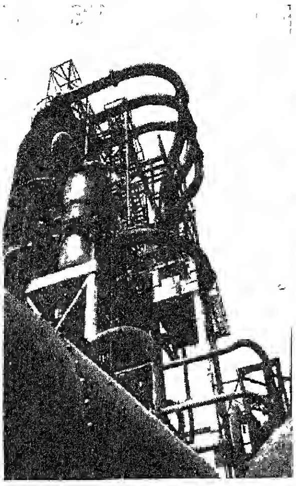
THE possibility of using molybdenum to replace nickel as an alloying element has a significance which goes beyond that of producing a more easily handled steel. Molybdenum is a domestic metal; that is, the largest source lies within our borders, whereas nickel is an imported element.* Substitution, therefore, means less dependence upon an essential import material in time of war. Tungsten is another metal which can be replaced in a measure by molybdenum, as we shall show later, hence replacements give a new meaning to the importance of alloy research.

Molybdenum also is employed in steels used for high-temperature and

*Scientific American, March 1936, page 139.



The flotation floor in one of the modern molybdenum recovery plants

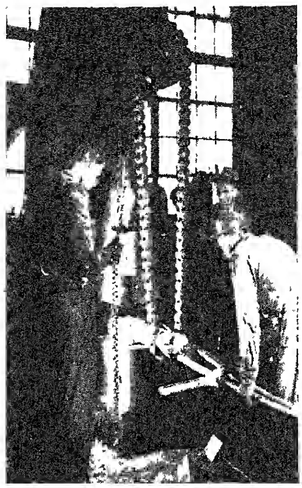


Moly for high temperature, high pressure service; it reduces "creep"

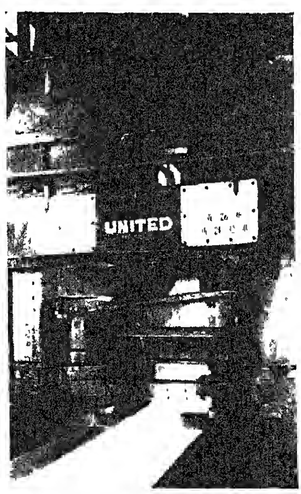
high-pressure service where the phenomenon of "creep," or the elongation of metal, occurs to create a very real problem. Through laboratory research and then through actual test in service, molybdenum has demonstrated an effective capacity to reduce creep. Thus, molybdenum steels are found today in the oil-producing and boiler-making industries. The oil industry desires to operate its cracking stills at high temperatures and pressures because it is more economical. The higher the temperature-pressure combination the greater the yield of desired products and the better the quality. Since 1920, the operating temperatures have been pushed up from 800 to 950 degrees, Fahrenheit, while pressures of 400 to 700 pounds per square inch have been raised to 1000. In vapor phase oil cracking units, temperatures may run as high as 1200 degrees, Fahrenheit. This advance has been made possible by the development of suitable steels, and that means a carbon-molybdenum steel to which some chromium or silicon and nickel have been added to give corrosion resistance.

THE problem of creep at high temperatures and pressure applies to boilers because here, too, higher temperatures are more efficient. Hitherto, steels which had the necessary service qualities could be fabricated only at excessive cost. Today, the molybdenum steels move in because they are easily fabricated, lend themselves to welding, and so provide the necessary properties at low over-all cost.

Of the four standard steels—carbon-molybdenum, chrome-molybdenum, nickel-molybdenum and chrome-nickel-molybdenum—a few words should be said about the last mentioned before passing on to the special steels. The outstanding characteristic of chrome-nickel-molybdenum steel is its fatigue strength



In forging, the new alloying metal permits a much wider forging range




Greater tensile strength, impact and wear resistance in steel mill rolls

and relative immunity to the temper brittleness which is found in most high-alloy steels. It is used for castings and heavy forgings, and wherever products must take severe and unremitting punishment. It is not a cheap steel and when it is chosen it is for quality alone.

Carbon-molybdenum steel has been referred to already as a satisfactory steel for elevated temperature service which classifies it as a special as well as a standard steel. For particular jobs, such as abrasion resistant castings, molybdenum is alloyed with manganese in steels. Other particular service calls for alloying in conjunction with such metals as silicon, tungsten, chromium, nickel, and vanadium.

It is hard to believe that molybdenum also has anything to offer in the way of corrosion resistance, but it has. More and more of the stainless (18-8) steels are appearing with molybdenum in parts requiring special properties, such as in many chemical plants and dye works.

Quite recently, molybdenum has been added to the high-speed steels used in the metal-cutting industry. Here is where we find tungsten being replaced. The established formula for the alloying elements, in percentages, of high-speed steel is: 18 tungsten, 4 chromium, and 1 vanadium. A new formula calls for adding 8 percent molybdenum and reducing the tungsten content from 18 to 2 percent. A defect of this "moly-fied" high-speed steel has been the formation, on heat treatment, of a soft surface skin due to the lowering of the carbon content; but experiments have revealed that the defect can be overcome by adding as little as 0.08 percent boron and 2.75 percent copper. One defect due to the copper-boron addition remains to be solved and that is the recovery loss in manufacture which runs a little higher than the standard formula steel.

Steel has so dominated the layman's picture of molybdenum that he scarcely knows of the contribution that it has made to cast iron. But today gears, cylinder blocks, valves, brake drums, and mill rolls are being produced with a molybdenum content, the purpose being to impart greater tensile strength, and impact and wear resistance. Molybdenum seems to be able to do this better than other alloys because it interferes least with machining qualities.

WHEN you know all there is to know about molybdenum's wedding with iron and steel, you still know only half the story of this interesting newcomer among the metals. It is true that the great growth in volume of consumption is tied to metallurgical progress, but molybdenum shows no inclination to be faithful to steel alone. Chemists have discovered other attributes of molybdenum and have put them to commercial use. This chemical rather than metallurgical phase of molybdenum development is quite recent and promises a dramatic, if unpredictable, future.

As we turn away from steel we discover molybdenum being used in the manufacture of color lakes, pigments, and ceramics, as a catalyst, and as an agent in bright zinc electro-plating. Since there is no particular connection between any of these developments we'll discuss them one by one.

When molybdenum is used as a chemical it is employed in the form of a compound, just as it is in the manufacture of steel where calcium molybdate is dumped into a batch of molten metal. One rarely encounters pure molybdenum. It is found in the ore as a molybdenite (molybdenum sulfide) from which it cannot be refined by orthodox smelting processes because it has a very high melting point (2620 degrees, Centigrade). Most of it is marketed in the form of calcium molybdate. In the vari-

ous uses which we shall now discuss. molybdenum compounds are being used because they give equivalent quality at lower cost, because they do a better job though higher in cost, or because they contribute an entirely new value.

Molybdenum is being used increasingly in the manufacture of color lakes, those insoluble colors made from organic dyes, principally to replace tungsten and thereby to reduce cost without any sacrifice of quality. It is also coming into use for pigments, the inorganic compounds, and the best example is molybdenum orange. In this instance chrome orange is replaced. Molybdenum orange costs about 60 percent more than the chrome compound, but it gives from two to two and a half times the hiding power, so that the net result is an economy.

In the manufacture of glass and enamels, molybdenum now figures as an opacifier. Pure molybdenum trioxide for glass, and lead molybdate or mixed crystals of lead molybdate and other insoluble lead salts for enamels are the compounds used. Researches to explore the merits of molybdenum trioxide and other oxides, when used as a component product for enamel ground coats and for the glass enameling of iron and steel, have proved that the quality of adherence is improved. Until now, nickel and cobalt have been used almost exclusively for this purpose, but molybdenum in conjunction with antimony not only lowers costs but produces ground coats of lighter color. This means that the thickness of enamel coats can be reduced, or that fewer applications need be made.

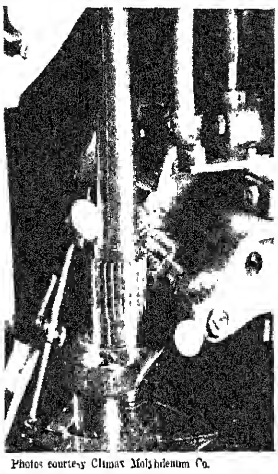
MOLYBDENUM is being used as a catalyst in the chemical industries both here and abroad, but it is still impossible to tell just how because very little, if any, specific data have been published. We can, however, get a hint of what is going on by scanning patents and reading between the lines of scientific literature. These scant sources of information make it definite that molybdenum is being used as a catalyst in vapor phase oxidation, in destructive hydrogenation, and in acid contact production.

It is known from experiments that the action of molybdenum as a catalyst is extremely violent, so much so that other metals have been mixed with it to slow it down, much as sawdust is added to nitro-glycerine to make dynamite. The knowledge of this powerful force has stimulated research to determine whether or not molybdenum might be mixed with fuels to accelerate their combustion and thereby derive greater efficiency from them. At this moment it can be said only that the outlook appears favorable.

We know that molybdenum acts as a catalyst in destructive hydrogenation because it is being so used in coal, coal tar, and mineral oil cracking processes in Germany. Practically every domestic oil refiner is conducting experiments, and again the outlook is favorable

The manufacture of sulfuric acid provides a good example of contact work. A cursory examination of patents indicates that molybdenum does not function alone, but apparently is of some undetermined value as an admix to vanadium and other compounds. Molybdenum will not combine with sulfur at high temperatures; in fact it is not at all easily contaminated in processes like most catalysts and that explains why it is favored for further research.

It is well-nigh impossible to cover in detail the entire range of molybdenum use in industry, yet a true picture of this surprising metal requires emphasis upon the little-known developments for it is here that we derive our conception of its future. Just to mention a few: molybdenum stainless steels are used for fountain pen nibs, while the compounds enter into the manufacture of light fast inks of brilliant hues; the radio industry consumes thousands of miles of molybdenum wire in the production of electronic tubes, and the telephone makers employ it in transmitting apparatus.



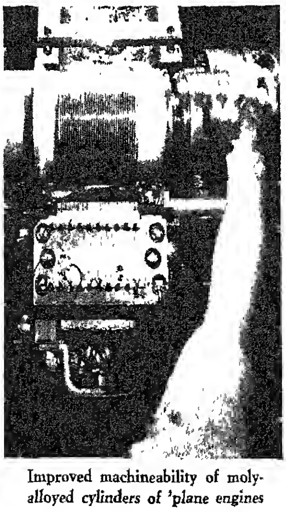
Photos courtesy Climax Molybdenum Co.

Engine crankshafts are alloyed with moly for high fatigue resistance

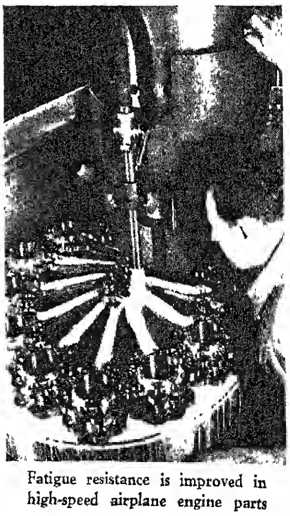
THE manufacturers of vacuum tubes have found molybdenum a valuable metal for a number of reasons. Sheet, wire, and ribbon are used in thermionic tubes, usually in very pure form. Occasionally molybdenum replaces tungsten for heater filaments in indirectly heated cathode tubes The property of retaining its strength at elevated temperatures, an inherent characteristic of molybdenum, made it valuable in this field just as it did in the manufacture of steel.

These varied uses mean very little in tonnage, but they are significant as hinting that molybdenum may be on the eve of tremendous expansion in directions which cannot now be delineated. Patents issued seem to support this view. But if you must know whence new developments are most likely to issue, keep your eyes on colors, rubber, leather, and photography because in these fields research is known to be pushing forward relentlessly.

Molybdenum, perhaps more than any other metal, is a research product, because research gave it commercial reality. What if the Greeks or the Romans did know about it? They couldn't make use of it. Research began with Scheele's discovery that it was an element, then on to Hjelm who succeeded in producing the pure metal four years later—1782, to be exact. It was research that transformed it from a graphite-like substance of no particular value to an element of commercial significance. Once adequate supplies were uncovered, it was workers in laboratories who made possible its front rank position in the world of alloying metals. What more could one demand in an alloy age?



Improved machineability of moly-alloyed cylinders of 'plane engines



Fatigue resistance is improved in high-speed airplane engine parts

# WHAT IS LIFE?

## The Greatest Puzzle of All Science Seems Today to Be Nearing a Solution . . . Yet, As it Breaks Up, its Parts in Turn Form Newer, Baffling Puzzles

By T. SWANN HARDING

THE question: What is life? has baffled mankind for ages. In recent times workers in science have sought not only to discover what life is but, as Sunday supplements tell us, to "create life in the laboratory." Still more recently something definite about that mysterious realm between living and non-living matter is in process of discovery by research workers upon the virus diseases which afflict human beings, animals, trees, and plants.

The effect of the virus disease known as peach yellows: the leaves droop and are wilted. Science may find a way to prevent this, but the main quarry is bigger

The greatest difficulty at the outset is, of course, to agree upon a definition of life. Life is a complex condition made up of a number of properties or characteristics. Set up almost any simple definition and the first thing you know someone will come along with a mineral, hence non-living substance, that will seem to fulfill the requirements. When medieval philosophers solemnly discussed whether such metals as lead and mercury were alive, their definition of life undoubtedly differed from ours.

But what is ours? In his "Life of Reason" the philosopher Santayana defined life as an equilibrium which maintained itself now by undergoing modification itself and now by imposing some modification on its surroundings. One modern scientist describes rather than defines life as a quality which endows certain chemical compounds with permanent existence. Hence complex chemicals like proteins (meat and eggs offer an example) would become stable, that is, would not soon "spoil", if they had the powers of growth and self-replacement.

Dictionaries usually start by blandly begging the question. They say, in effect, that life is that property which distinguishes living from non-living matter. Then they usually go on to say that living matter can grow, reproduce itself, make internal adaptations to its environment, maintain itself by taking in food, building up and tearing down tissues (metabolism) and excreting waste matter, replace its damaged parts, and hand down certain characters in an hereditary way to its offspring.

That gets us somewhere, but even this definition is tricky. For what about a chemical compound that does not ordinarily grow or reproduce itself but which will, if placed in a certain environment or given a certain food, grow, reproduce, and maintain itself? Is it living or non-living? It has some of the properties of a living thing. Must it have all of them really to be alive, and have them all the time?

Modern chemistry holds that living and non-living substances may differ very little in chemical structure. The difference is sought rather in some new geometrical arrangement of their atoms or molecules. Hence what we regard as mineral matter, or as a mere non-living metal, may from time to time become "alive" due to some mysterious internal change in the pattern of its atoms and molecules. So it is easily possible to imagine that a complex protein might, under certain circumstances, rearrange itself internally and begin to live.

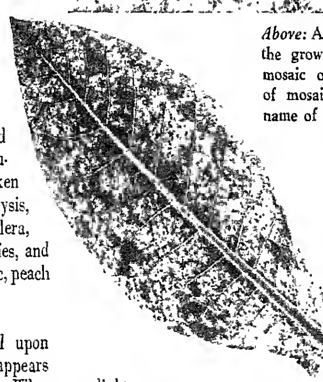
LIVING things may vary in size from a whale, the largest animal of all time, to a single-cell bacterium or a bacteriophage. Most of the organisms that cause disease are very minute, but they are not only alive; they have a very complicated structure, as Alexis Carrel has shown. Some consist of but a single living cell which is the structural or functional unit of the plant and animal world, as the atom is of the mineral world. But even the single cell is by no means the mere "drop of gelatine surrounded by a semi-permeable membrane" carelessly described by some biologists, for a cell has organs: look up its picture in a big dictionary. It contains the full genetic machinery of inheritance, the genes and chromosomes. It contains an elastic-walled balloon called the nucleus, which seems to be full of inert, transparent jelly. It contains numerous small particles which are in continuous violent

A cow, drooling at the mouth. It has hoof and mouth disease, caused by a virus. The only "cure" is to kill cattle thus infected and bury them deeply to prevent spread or a pandemic

agitation. Some have the special function of nourishing the cell; others appear to be granules, globules, and long filaments, whirling and dancing endlessly.

If the structure of the cell is baffling, its chemical composition is still more intricate. Generally speaking, it is said to consist of "protoplasm," but the minute the biologist tries to analyse this it ceases to live and hence is no longer protoplasm, for life is one of its properties. Even the nucleus, which appears to be empty, contains those marvelous but mysterious agents which rule the hereditary tendencies of both cells and men.

We turn to the bacteriophage* and find a still smaller living thing, yet one capable of destroying malignant bacteria. Still smaller, so small that they pass through the biologist's best filters, and elude his highest powered microscopes, are the so-called virus particles which produce human diseases like smallpox, chicken pox, mumps, and infantile paralysis, animal diseases like hog cholera, foot-and-mouth disease, and rabies, and plant diseases like tobacco mosaic, peach mosaic, and sugarcane mosaic.



*Above:* A test showing the stunting effect (at right) on the growth of tobacco plants when infection with mosaic occurs early. *Left:* Typical mottling effect of mosaic on the tobacco leaf, giving rise to the name of the disease. A sub-microscopic virus causes it

TODAY attention is focused upon these virus particles, for it appears they may soon answer the question: What is life? In the old days scientists attacked the problem differently. When, in 1828, Wöhler reported having made the organic chemical compound produced by the human body and called urea, but announced he had done so independently of the body, purely synthetically and by artificial means, he himself thought this discovery marked a break with the past. It had been believed that no chemicals elaborated by organisms could be made in the laboratory. Wohler had proved the contrary. Soon more and more complex compounds would be made in the laboratory and then life itself would be created there. Therefore, many workers tried such things as letting prussic acid stand in water in the sunlight, to find that a number of complex chemical compounds formed spontaneously in the solution. It was shown that sugars could be made in the laboratory from water, carbon dioxide, sunlight, and a coloring matter—just as plants made them "photo-synthetically;" that is, synthesizing them with the aid of sunlight.

But there was a limit to such experiments. Common glucose, if left standing in water, will generate a variety of chemical compounds but that is far from producing life. The new attack of science on this old problem is by way of the ultra-microscopic particles which cause a wide variety of human, animal, and plant diseases—influenza possibly being among them, and measles, range paralysis, and the plant mosaic diseases being notably included.

New and strange findings have been made, which have tremendous significance both from the standpoint of disease causation and from that of the basic nature of life. While a great deal of the work has been done on the destructive mosaic disease of tobacco, which has economic importance to all tobacco growers, that is only because the research worker finds his easiest point of attack here. Human diseases are indirectly but certainly involved.

If we thought the bacterium was small we "haven't heard anything" yet. These infective virus particles are, to make a bull, smaller than the bacteria and the bacteriophage put together. According to Dr. W. J. Robbins of the University of Missouri you would have to place 14 ciphers after the figure 10 to represent the number of infective virus particles contained in 20 drops of the juice extracted from a tobacco plant down sick with mosaic disease.

And is that juice infective? It is so infective that it will still cause disease when one part of it is mixed with 10,000 parts of water! Think that over, remembering all the time that quite similar infective particles spread a whole list of human and animal diseases. Are those particles alive? That is the question, and it leads right to the center of the mystery of life itself.

As early as 1932 our leading medical journal was telling its readers that these infective particles had been crystallized out and found to be a chemical substance, a protein, the kind of chemical we know best as lean meat. The journal called this substance a "pathogenic enzyme," an enzyme being a ferment, hence a ferment capable of causing disease. It said that this work "may be regarded by future medical historians as one of the most important advances in infectious theory since the work of Lister and Pasteur."

THAT sounds startling. What had happened? A protein substance had been found which, in its pure crystallized form certainly was not alive. But put it in contact with normal living tissue cells and, behold, it would begin to act like a disease germ! It began to multiply. It began to reproduce itself, to spread, to cause disease. Had non-living matter thus suddenly become living? The question is actively debated today.

The work continued. Dr. W. M. Stanley of the Rockefeller Institute for Medical Research took the most prominent part. By the middle of 1935 he reported that he had isolated a crystalline protein from diseased tobacco leaves which would, if injected into healthy plants, produce mosaic in them. These crystals became self-propagating under such circumstances, though they were not, strictly speaking, alive.

*Editor's Note:* An ultra-microscopic, living organism parasitic on bacteria and reproducing itself. Literally the word means "one that eats bacteria." This recalls Dean Swift's famous verses:

So naturalists agree, the flea
Hath smaller fleas that on him prey,
And these have smaller fleas to bite 'em.
And so proceed, ad infinitum.

There are "smaller fleas" than the bacteriophage (pronounced to rhyme with garage) but no evidence that these smaller "fleas" actually "bite 'em;" which is not, however, to derogate from Dean Swift's amusing verses written years before Twort and d'Herelle's discovery of the 'phage, in 1915, 1918.

Dr. Stanley called this strange substance an "autocatalytic protein." In simpler terms these rather forbidding words mean that virus particles causing plant, animal, and human diseases consist of a proteinlike substance which, ordinarily, is non-living, but which, under certain favorable conditions, manages to steam itself up and to act very much indeed as if it were alive. All right: Is it alive then? Or is life a potential property that may arise almost anywhere under favoring circumstances?

A little later Stanley announced that he had crystallized the same identical protein from tomato plants afflicted with mosaic as he had from the mosaic-affected tobacco plants. He said he could produce mosaic disease in either kind of plant simply by injecting this protein into healthy individuals. That looked as if a non-living protein turned into a living infective agent when once injected into a plant.

COULD anything be done to the protein which would deprive it of its strange power? Could it, in a manner of speaking, be killed? Could its potential life be snuffed out? Yes, it could. For in 1936 Stanley announced that the protein could be "inactivated" permanently by treatment with certain chemicals or with ultra-violet light rays. Just how did this occur?

Well, really drastic treatments changed the protein chemically, partly broke it down, partly destroyed it. But less drastic treatments would deprive it of its power to "come alive" when injected in the plants, yet without making any perceptible chemical change in it. These mild treatments would only make the protein lose its power to cause disease or to become self-propagating under favorable conditions. So Stanley concluded that the enzyme (or the ferment) part of the structure was injured by these mild agents, hence the protein was no longer autocatalytic. So, not only can life be killed, but the potential power to come alive under favorable circumstances may be snuffed out.

But the protein has another interesting property usually associated with living things: It can adapt itself, it can mutate. The offspring may suddenly begin to differ from the parents, as is the case with so many plants and other living things. Variation may set in.

For example, tobacco is afflicted with two different kinds of mosaic disease. One is called "common" and the other "yellow" mosaic. They have different symptoms. But common mosaic often spontaneously changes over (or mutates) into the yellow form on a tobacco plant. Yet, if a plant is affected with common mosaic and is then attacked by the yellow form, the former holds the latter in check. There is also a virus affecting wheat which mutates from a green to a yellow form of the disease.

These strange goings on are not limited to plants. They occur among animals, doubtless among human beings too. For example, there are two very decidedly different rabbit diseases—infectious *myxoma* and infectious fibroma—both attributed to virus particles. Under certain laboratory treatments scientists have learned that these may be made to mutate. They can transform one virus into the other at will, though one of the diseases is rather mild and unimportant, the other malignant and usually fatal.

**SO important is the subject dealt with in the accompanying article—namely, the discoveries of Stanley and others which seem to point toward the solution of the biggest problem of science as well as to practical possibilities like learning better to combat virus diseases in man, animals and plants—that two articles, the second to follow later, are being devoted to it. Everywhere men of science are discussing these deeply significant virus researches, and the feeling is widespread that a new period of biological advance may have been opened up. The purely biological implications are even far wider and deeper than the practical ones. An answer to the old question of what life is might, if found, bring along with it that of the other old question, how did life start? We may learn more about the cause and method of evolution, for the gene or determiner of inheritance is involved, and we might—though this is definitely speculative—learn basic facts about cancer. If life were shown to be "mechanistic" instead of "vitalistic," the repercussion on our philosophy and outlook would almost certainly be heavy. Science eagerly awaits the outcome. —*The Editor.***

Undoubtedly the same thing happens in human beings. There are said to be 32 distinct types of pneumonia, and each type is doubtless caused by some subtle change in the chemistry of the infecting organism. Organisms constantly mutate, but they are generally regarded as definitely alive. Now viruses have been found to mutate. Why not regard them as alive? But can a crystalline protein be alive?

A virus can produce a very specific disease, as can a germ. The fibroma virus mentioned above produces a benign, harmless local tumor in rabbits, but the myxoma virus produces a malignant, cancer-like tumor. Yet if "living" virus of one kind is mixed with "dead" virus of the other, the former—mind you—takes on the attributes of the latter and will then produce the rabbit disease usually produced by the latter.

Obviously these two viruses must belong to a single basic strain, or they must be minor variations of a single substance, perhaps a protein. But two proteins may appear to be identical on chemical analysis, yet one may, under favorable conditions, prove capable of reproducing itself while the other may not. Hence it has been suggested that some geometrical rearrangement of the pattern of the countless millions of atoms and molecules constituting a chemical compound may endow it with what we call life.

In this dim, twilight zone between living and non-living matter, Dr. John Howard Northrop of the Rockefeller Institute recently found a germ-destroying protein that acted like bacteriophage. In some strange manner this protein appeared to have acquired the power of self-multiplication, a characteristic of living matter, when placed in the presence—not of living tissue—but of certain bacteria. In acquiring this power it resembled the disease-producing virus particles which also begin to reproduce themselves under favoring conditions.

WILL the next step be the formation of apparently living bacteria themselves from proteins that are ordinarily non-living? The crystallization of a seemingly non-living agent that is capable of producing infection and disease presents a borderline case. The virus appears to stand somewhat nearer to life than to non-life. It is a protein that definitely starts to rebuild itself when placed in contact with living tissues, but it does not seem to possess all the properties we usually associate with life.

Speaking in May, 1936, Stanley said: "The idea that proteins, which suggest meat and eggs to most of us, can be viruses and produce disease, is new and startling. But there is no longer any doubt that this virus activity is a property of the protein itself. The only explanation is that somewhere along the line between life and death there is a middle ground where chemicals have the attributes of living organisms without being themselves alive."

The pill has been too much for the bacteriologists to swallow. They tend to resent the very idea that these proteins which multiply and undergo mutations like living things are also in a sense non-living, yet cause disease. Stanley had little to say about this beyond suggesting that bacteriology may soon have to cede to chemistry priority in the struggle against disease.

Meanwhile the riddle of life remains unsolved, but science is closer than ever to its solution, in so far as the distinction between living and non-living matter is real and not merely verbal.

# Snake Dance Secret Bared

## Why Venomous Snakes Cannot Injure the Hopi Indian Priests . . . Explanation Is Simple

A CERTAIN educated Hopi Indian, whose name for reasons of policy shall remain undisclosed, has revealed a secret which long has mystified Americans who are interested in southwestern Indians: the nonchalant immunity with which Hopi priests and medicine-men handle poisonous sidewinder rattlesnakes in ceremonial dances.

Numerous hypotheses have been advanced as probable explanations by curious witnesses of the annual Snake Dance ceremonial. Some have believed the snakes are rendered harmless by removal of fangs and venom sacs; incorrect. Others have believed the snakes temporarily innocuous as the result of previously administered sac-paralyzing treatments; wrong again. A few, observing the be-daubed and painted skins of the half-naked dancers, have conceived the hypothesis that mysterious antidotes were blended with the decorative covering. That hypothesis, too, is unsubstantiated.

As with most baffling natural phenomena, complicated speculative reasoning has led mystified beholders of the Snake Dance by labyrinthine ways from elementary deduction. The simple fact of the matter is that the snakes are goaded into exhausting the venom sacs before the ceremonial dancing has begun.

A few ethnological students have reported certain phases of preparations preceding the public appearance of the Hopi dancers and their scaly "partners." It has been said: "—the snakes are taken to the Snake *kiva* (ceremonial room), where they are washed and prepared for the ceremony." While the "preparation" has been the cause of varied speculation, not even traders in the Hopi villages seem to have gleaned the positive facts, or, if they have, they dared not risk the animosity of the dominating medicine-men.

The educated Hopi who revealed the simple matter openly boasted of his Christianity and laughed at superstitious secrecy concerning matters so elementary—when he was away from the Hopi Reservation. But he requested that his name be withheld from any discussion of the matter for, in spite of government supervision of matters on the Reservation, the medicine-men hold powers of life and death over lesser members of the tribe.

After having been washed according to the ritual laid down by the legendary Snake People of the Underworld, the poisonous snakes are tantalized, infuriated, and caused to strike. The goads are long wooden poles. The targets for the fangs of the snakes most often employed are hearts or livers taken from freshly slaughtered animals. Sometimes the entire carcass of a young jackrabbit or a prairie dog may be used.

The inanimate flesh of the bait absorbs the venom which is discharged by the striking snakes. Again and again the reptiles are permitted to sink their fangs into the bait, until there seems slight chance of venom remaining available for immediate use.

This "milking" of the snakes, performed in the snake kiva under careful supervision of the soon-to-be-performing dancers, is continued until the priests are ready for appearance. The snakes then are thrust into a bag, carried into a cleared space among the buildings on the mesa, and placed, still in the bag, within a pit in the mesa floor. A wooden plank is laid over the mouth of the pit.

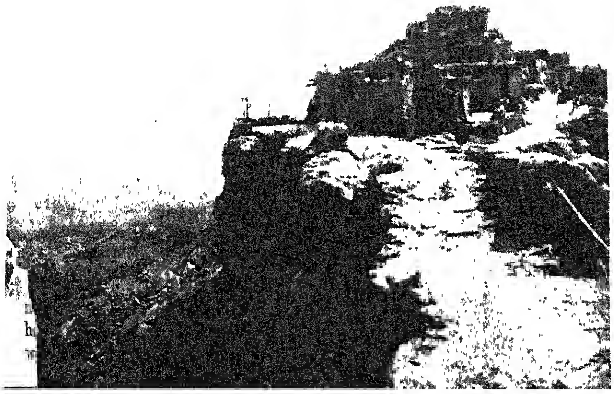
After formal preliminary maneuvers in the snake plaza, the line of dancers approaches the pit containing the snakes. The dancers advance in double file. One member of each pair carries a light wand having a tuft of feathers at its free end—a "snake whip," for attracting the snake's attention in the event of too great animosity.

THE companion dancer, priest of the ancient Antelope clan, stamps his feet upon the wooden plank covering of the snake pit, as though seeking admission. After a moment's pause he slips the plank aside, plunges naked hand and arm into the repulsive mass of squirming serpents, grasps the most convenient one and triumphantly waves it above his head.

Timorous onlookers gasp, as the dancer closes his mouth about the body of the snake, which may be a six-foot rattler. It might be, instead, a Great Basin striped racer ("whip snake"), or an Arizona gopher snake ("bull snake"), neither of which is poisonous, both sharing the northern Arizona desert with the poisonous prairie rattlesnake, the sidewinder. But, when he thrust his hand into the bag, the Antelope priest had no chance for selection or comparison of virtues. He clutched the first slippery candidate that came within his grasp.

Stripped of masks and tom-tom throbbing, incantations and pseudo-sorcery, the solution seems elementary as a Sherlock Holmes deduction.—*J. S. M.*

**Old Walpi, pueblo of the early Hopi Indians, in Arizona, thought to have been established about 800 years ago. The stone stairway leads to a spring far below the mesa**
hoto by Pennington, Durango, Colorado



# What Is Personality?

By P. F. VALENTINE, Ed. D.
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PSYCHOLOGISTS have gotten us into a predicament over personality. We have been going along cheerfully with the assumption that personality is the normal property of a human being, but the psychologists, in trying to get at it and find out what it is, have succeeded only in identifying a lot of separate parts and functions. The thing itself—presuming that there is such a thing—dissolves upon analysis, like a wet lump of sugar. Baffled, the psychologists have tried to reassemble the pieces and get personality synthetically. But all the king's horses and all the king's men can effect nothing better than a bundle that refuses to be an entity such as personality ought to be.

It is possible that all this difficulty is due to an unwitting effort to translate an abstract into a concrete. We want to see the thing, define it in space and time, measure it. Learned men were long since troubled in a similar way with respect to the soul. The pineal gland was once pronounced to be the container of the soul substance; we have heard of solemn experiments where human beings were carefully weighed immediately before and after death to ascertain the soul's weight. Perhaps personality defies our efforts at concrete definition for the same reason that the soul does—because it is an airy child of metaphysical birth, a thing that is not a thing but a thought. Our search may always prove as fruitless as that of the lad who sets out to fetch a piece of the rainbow in his lunch basket. The beginning and the end of personality may be nothing more nor less than the state or quality of being a person. In that case it is an abstraction, a thing of the mind, and as such is food for the philosopher rather than the psychologist.

Perhaps the state or quality of being a person cannot be defined. Try to tell what a human being is without using the language of anatomy or physiology. State if you can, without resort to possible synonyms that are equally ambiguous, like mind and spirit, just what the essential of selfhood is.

The abstract personality remains, in spite of its potency, an idea. It may be no more real than Nirvana, but exist only in the meaning of a word, as it would be if we spoke of the "enginality" of an engine or the "ideality" of a temple's architecture. Obviously, this is not the kind of personality we talk about in ordinary conversation. It is not the kind that is advertised by billboard psychologists and publicity agents for movie stars. It is not the kind that is admired, according to one's taste, in super-salesmen, philanderers, sophisticates, orators, ambassadors, crooners, generals, poets, or swamis. It is not, it may be added, the kind of personality that serious psychologists are trying to analyze and describe.

The personality of popular interest and popular ignorance—the personality that challenges the psychologist—is real. There is the fact that each individual makes his own peculiar impact upon others. And there hangs the issue, for, according to the popular notion, this personality is a kind of entity that exists in its own right, while the typical psychologist sees it only as a sum or combination of various distinguishable parts.

THIS impact of an individual upon others is a legitimate problem for the scientific psychologist, for his study is human behavior. The impact is conveyed through behavior, and behavior is open to experimental observation. Also, the conscious states behind it are open to introspectional analysis. By introspection we do not discover a thing at work called personality; we find sensations, pleasant and unpleasant feelings, memories, perceptions, ideas. By the observation of visible behavior we discover a number of things variously called habits, traits, dispositions, behavior patterns, mannerisms.

It would seem, from the results of psychology, that the familiar thing called personality is not a thing but a bundle of things. Or one might say that it is like the quadruped, which, verily, is not an animal at all. Who has ever seen a quadruped ambling by? One has seen a horse, an elephant, a mouse; but not a quadruped. The word is merely a convenient term for the classification of four-legged animals. Personality, likewise, it would seem, is a term of classification.

The personality testers, so far as these are found among reputable psychologists, have long since accepted this principle. None of them tries to measure the thing itself, for they have not found any such thing. To revert to a previous conceit, would one hope to measure the "enginality" of an engine? Or would one not be compelled to content one's self with measuring the horsepower, the revolutions per minute, the compression, and so forth? In the case of personality, the psychologists have been busying themselves with the invention of tests for measuring the parts. As a result we now have hundreds of more or less dubious appraising devices designed for evaluating such constituents as these: intelligence, artistic capacities, interests, knowledge, technical aptitudes and skills, temperamental characteristics, tendencies of ascendancy and submission, introversion and extraversion, emotional dispositions, psychoneurotic tendencies, evidences of volition, and social, moral, ethical, religious, and esthetic attitudes and habits.

In this array there is a startling suggestion that our personality is a pied thing of patches. But the half has not been said. For it now appears that the patches are but collective terms embracing any number of separate parts of their own. Intelligence, for example, is psychologically described as something consisting of an untold number of distinct "reactions." And when it comes to our moral make-up, to cite but another example, we find that it is bad psychology indeed to assume that it consists of traits such as honesty, fairness, obedience, dependability, and the like. For we have discovered that these do not exist in their own right, as moral entities with a real existence. Like the quadruped, each is but a collective term for a great number of things.

Take, for example, honesty. It is commonly believed that a moral person has something that goes by this name. A great deal of careful scientific research has been prosecuted to find out about it. And the result is pretty clear evidence that the so-called honesty of a person fluctuates according to the conditions prevailing at the moment. An extensive battery of genuine tests of honest behaviors was imposed upon thousands of children who did not know that they were being tested for anything, and no evidence of consistency was found. A child honest in some situations would deceive in others. Honesty decomposes into honesties, and there are as many possible ones as there are tempting positions in which an individual may find himself.

At the rate we are going, personality will eventually become pulverized.

In childhood, psychology robs us of our Santa Claus; and when we grow up it robs us of our personality. At Christmas time, however, there is always some compassionate soul who rises up to assure us that after all there *is* a Santa Claus. The writer now proposes to perform the same benevolent resurrection for Personality.

Philosophers long ago thought that they had destroyed apples. They showed with much logic that what we call an apple is but a bundle of qualities. They explained that you can break one down into redness, smoothness, roundness, hardness, odor, taste, and the like. And what is more, they demonstrated that all these qualities really do not exist in the apple. They exist in your mind. Smoothness, for example, is a sensation that happens when the nerve endings in the hand are stimulated in a certain way; it happens in your consciousness. You can thus remove all the qualities of the apple to your mind, and the question then is: What has become of the apple?

One of our modern schools of philosophy is busy restoring apples, and the successful accomplishment of this feat promises to bring lasting glory to certain American philosophers. A similar service to personality seems to be in order, for common sense insists that personalities are as real as apples. The impact of a person upon others has a consistency and a reality about it, we feel sure, in spite of the disintegrating discoveries of the psychologists. The parts make a whole, and the whole is not the same thing as a bundle: it is something different from a mere collection. We have an intuitive conviction that it exists in its own right.

AN intuition is dangerously unscientific. But this particular one is supported by any number of scientific facts, as well as by numerous experiences of common life. These all demonstrate the important principle that related parts form unique wholes which are in no sense a simple association of the parts, but possess a distinctive character of their own.

The simplest illustration of this principle is water. Every schoolboy knows that it is composed of one part oxygen and two parts hydrogen. But how different it is from either of them! Imagine drinking oxygen or doing the family washing in hydrogen. The fact is, of course, that water is a thing unique in itself, created by placing two elements in certain chemical relations to one another.

Chemical compounds illustrate the same principle. Divers elements of extraordinary unlikeness get together and we have entirely new substances, beyond the elements themselves.

Music illustrates the same principle in a strikingly different fashion. Consider a melody. Here we have a collection of parts consisting of notes. Or if you prefer larger parts, say that they consist of phrases. In any case, the parts, as such, by no means constitute the melody. If they did, you would have the melody no matter how you arranged the parts. But the fact is, of course, that you have the melody only when the parts stand in certain relationships to one another. Then each part gives up the character that it possesses when standing alone. It goes into the melodic whole, but the melodic whole changes it. Each part assumes a quality that is aroused by those that precede and by those that are anticipated.

A new biology is being written around this principle. The living cell of protoplasm, ultimate unit of all life, is no longer a mere assemblage of chemical elements. The very fact that it possesses life means that its parts are active with respect to one another in a manner determined in large measure by the cell as a whole. The parts make the whole but the whole governs the parts—strange and paradoxical law of nature!

What is true of the single cell is true in a remarkable way in the mass of cells that form a complex organism. At an early stage in the development of the embryo of a frog, for example, a portion that would normally become skin may be transplanted to the brain region, and it will become brain. In a similar way the fate of various parts may be completely changed. Zoölogists have studied this phenomenon with extreme care, and they have discovered that an organizing influence pervades the living, developing structure. It dominates the structure, determining growth in an orderly fashion and compelling cells to become what they should become in accordance with the needs of the functioning whole.

Perhaps the bearing of all this upon the enigma of personality is beginning to appear. The psychologists left us with personality shredded into parts, and parts of parts—and they couldn't put Humpty Dumpty together again. But now we catch the glimmer of a unifying principle that ought to shine with much light as one traces it through higher orders of nature. A little knowledge of human physiology offers an insight that ought to prove illuminating. One need only take into consideration the amazing balance of functions in the body to realize that it is something more than a collection of working parts. One may select any single function and show that it influences every other one, and is influenced by them. Digestion, assimilation, excretion, circulation, respiration, functioning of ductless glands, liver, and kidneys—processes so involved in reciprocation that explanation becomes lost in the simple, and finds itself only when it turns to the complex! Explanation, here as elsewhere, must be discovered in a principle of organization that emerges from a maze of functions, and upon their diversity bestows an ordered unity and wholeness.

Psychology itself, in some of its recent phases, is yielding to these principles of organization. The *Gestalt* school and the new purposive behaviorism are compelling a radical revision of dominant structural and mechanical theories—psychologies of pieces and parts. Analysis of the behavior of rats and men had given us a picture composed of fragments, and we thought the fragments were the last word. Now we are beginning to see, like workers at a jigsaw puzzle, that the ideally complete picture governs the function of each part from the beginning.

Thus, by the aid of much science and some philosophy, is personality restored. It turns out to be a real something possessing a kind of unity. This conclusion offers no consolation to simple people and mountebanks who have talked of personality as if it were a center of magnetism, a mysterious well of power, or a secret of the mind which, if you but possess the key (price 25 dollars), will lead to success in business and love. No; the unity that is personality is the unity produced by parts existing together in functional relationships. For in such case we have something more than a mere collection of parts. Mutually, the parts have created a principle of organization that extends throughout, and the effect is unification. This is personality.

THE parts thus organized are not mechanical, like those of a machine—not like wheels, bearings, cylinders, cogs. They are psychological: emotional dispositions, habits, social attitudes, temperamental characteristics, ways of meeting various situations, active interests, moral behaviors, esthetic sensitivities, fears, timidities, forms of self-assertion, and what not. These terms all indicate functions of behavior that may, upon this, that, and the other occasion, be identified in persons. They may be identified separately but they are inter-related in fact. They are parts of behavior in the same sense that peculiar sequences of steps are parts of a complicated dance. The sum and substance of it is that each peculiarity of behavior is what it is largely by virtue of the character of the others, severally and collectively.

All in all, we have a synthesis which is personality. Its effect and visible evidence is the familiar impact of an individual. In this, no two people could possibly be alike. Obviously, it is not susceptible of measurement. And it is not a thing responsive to the hocus-pocus of platform psychologists or mystic cultists.

# WEATHER DATA BY RADIO

## Our Weather Influenced by the Stratosphere . . . Radio Transmitters Anchored at High Altitudes to Send Out Thermometer and Barometer Readings

PRIOR to the close of the 19th Century, weather observations were confined largely to conditions close to the surface of the earth. In 1899 a pioneer French meteorologist Teisserenc de Bort, made the announcement that the temperature decreased at a fairly uniform rate as altitude increased and that this fall in temperature ceased at from 11 to 18 kilometers above the surface of the earth. The zone above this height is called the "stratosphere," and the lower region in which temperature decreases with height is called the "troposphere."

Radio transmitting equipment is in wicker basket; balloon gondola at center

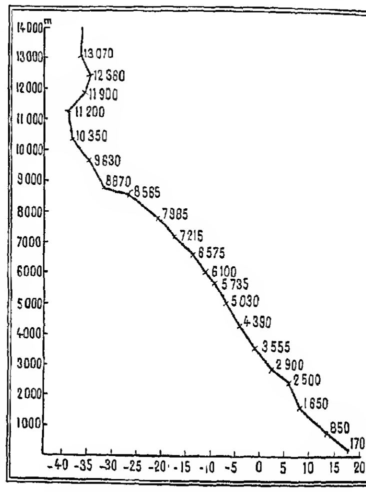
Since the turn of the century, important progress has been made in predicting weather conditions, and particularly has this been true during the past decade, thanks largely to the rapid development of radio communication. The importance of the stratosphere and the rôle which it plays in the meteorological research is well known to present-day students of the subject. The opinion was expressed as long ago as 1911 by W. H. Dines, a British scientist, that all the atmospheric disturbances close to the surface of the earth are due to the influence of the stratosphere.

Explorations of the upper air mass, as undertaken by de Bort, among others, paved the way for a systematic study of the stratosphere and its effect upon the climate. In an attempt to gather weather data at points far above the surface of the earth, de Bort made use of sounding balloons as far back as 1892.

During the present century this type of work has been carried on consistently, frequently with the assistance of airplanes, flights of which, however, are severely limited by mechanical considerations. Only by means of sounding balloons is it possible to penetrate the stratosphere and to obtain information that can be put to practical use.

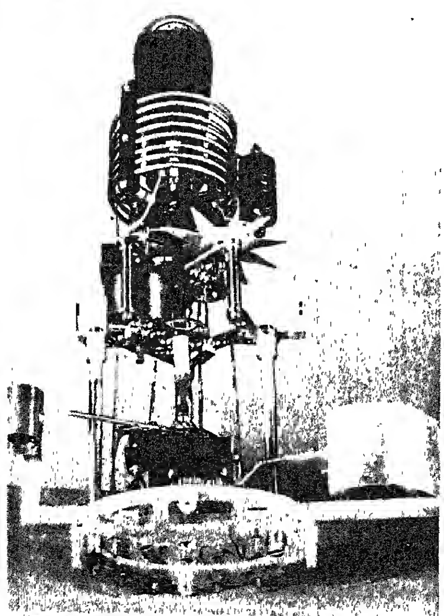
The method generally in use today for gathering the secrets of the upper air is to attach weather instruments to a balloon, which is then set free. When the balloon reaches a certain altitude, it bursts because of decreased external pressure and the instruments descend to earth, their fall broken by a parachute.

While this method has contributed greatly to the collection of weather data, it has several disadvantages. If the instruments are recovered immediately the data will be of maximum importance. Very often, however, there is a delay in the return of the instruments by the finder, as frequently a balloon will have drifted many miles from the point of release. Furthermore, while great heights have occasionally been reached by free sounding balloons, the greater the height, the greater the disadvantage, because the balloon will drift to a greater distance from the point of release.




Temperature decreases as altitude increases

At Trappes Observatory in France experiments have recently been conducted with a captive balloon equipped with a new type of radio transmitter which continually sends out signals, making possible a constant check upon changes in atmospheric



Photographs from Mirzaoff

Star-shaped wheel is below radio instruments. Pressure and temperature units are at the left and the right

# From Captive Balloons

conditions at high altitudes. The first record of this type of work is dated March 3rd, 1927, when a balloon carried a barometer and a thermometer to the stratosphere and kept in constant touch with a ground receiving station by means of an automatic transmitter. Since then experiments have been conducted to further the flexibility of this means of weather data collection by officials of the National Bureau of Meteorology of the French Government.

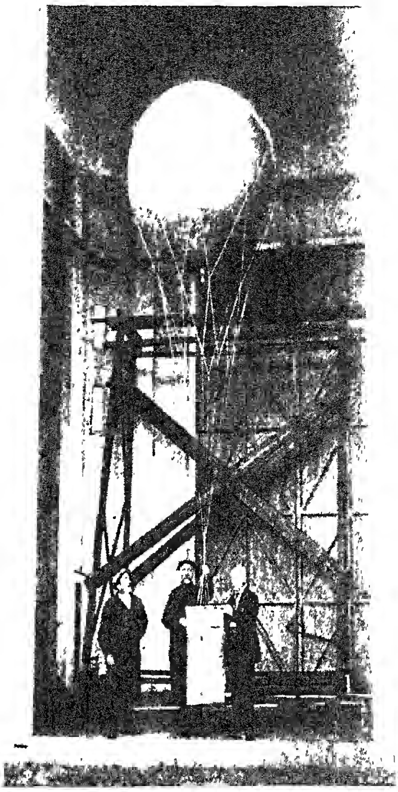
ESSENTIALLY, the radio sounding equipment consists of two recording devices and an automatic radio transmitter. A metallic coil expands and contracts with changes in temperature and a sealed capsule acts in the same manner with changes in barometric pressure. The barometric changes cause radio signals to be sent out, while changes in temperature vary the space between signals. Working along these principles, the French scientists have perfected a light and compact radio transmitting system which has been carried to heights of 14,000 meters by means of a captive balloon and stationed at that point for days at a time.

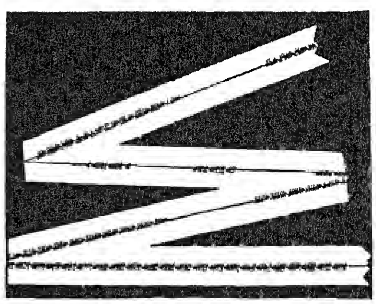
In the equipment which is illustrated on these pages there are a fixed index and two rotating arms which control the radio transmission. The position of these arms governs radio inpulses which are received by the ground station and recorded on a moving paper tape. The equipment is so arranged that it will transmit simultaneously records of both temperature and pressure. The coil and capsule mentioned above are so connected mechanically that they cause their corresponding arms to move around a single vertical axis. As shown in one of the sketches, each arm describes a definite arc upon a so-called "exploration platform." On this platform there is a stationary piece of metal shaped like a fork with a handle and four prongs (F0, F1, F2, F3, F4). The arc between F0 and F1 is covered by the barometric arm, and arc F4, F0 by the thermometric arm. Then there is a "guide" (indicated in the sketch by an arrow) that sweeps over the edge of the platform, making a complete circle. As the guide encounters in successive periods one of the arms or a prong of the metallic fork, an impulse is transmitted which is registered at the receiving end by either a straight or a wavy line. The movement of the guide is supplied by a clock which at the same time rotates another metal disk shaped like a star with ten points. This is parallel with the "exploration platform" and records the angles of both arms.

The star-shaped wheel rotates between the plates of a small condenser, the latter being connected in the plate circuit of the transmission tube. The passage of each spoke, therefore, is translated into a modulation, and the circuit is so arranged that transmission stops momentarily when the "guide" comes in contact with one of the two arms or one of the four prongs of the metallic fork.

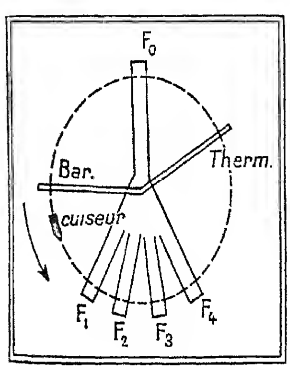
The radio transmitter itself consists of a conventional oscillating circuit in which a single vacuum tube is operated by dry cells. When the impulses are received by a conventional receiving set at the ground station, the signals are fed into an oscillograph which registers the impulses on a moving paper tape, in the shape of straight and wavy lines. A sample record is reproduced herewith, showing wavy line records for barometric pressure and the straight line records for temperature.

One of the greatest advantages of this French system of meteorological research lies in the use of a captive balloon which, held by its light yet strong silk cable, can, under ordinary circumstances, remain at high altitudes for long periods of time.

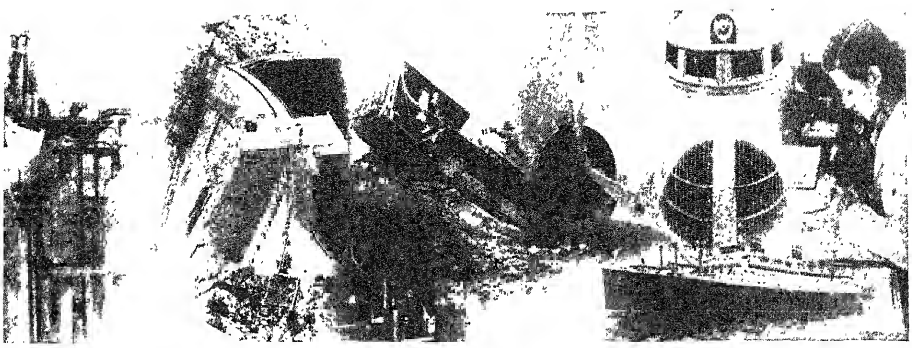




***Above:*** **One of the captive sounding balloons ready for release. In the fabric gondola is the radio transmitting apparatus that will send continual reports to the ground station.** ***Right:*** **Several sections of the tape record made at the radio receiving station**




**The fork-shaped contact piece on the "exploration platform." The operation is explained in the text**



# THE SCIENTIFIC AMERICAN DIGEST

Conducted by F. D. McHUGH

Contributing Editors

ALEXANDER KLEMIN
In charge, Daniel Guggenheim School of Aeronautics, New York University

D. H. KILLEFFER
Chemical Engineer

## Smoke Out Thieves

IT is now possible completely to frustrate thieves and recover messenger bags containing valuables within a few seconds after a holdup occurs.

The messenger hands over the bag without resistance! Yet, in less than a minute, the bag is recovered, its contents intact and unharmed; and the thief is apprehended.

This protection is afforded by the Tracelarm messenger bag in which is a special noise- and smoke-producing shell.

The Tracelarm shell is a sealed, self-contained unit with a series of four .45-caliber blank cartridge noise-loads giving four rapid detonations and charges of tracer-smoke that issue without interruption for three or more minutes. The shell is equipped with dual-ignition to insure positive operation, and the safety fuse provides a silent delay period of 10 seconds before discharge of alarm or smoke. There are no batteries or other delicate elements to require attention, and the shell will remain in first-class working condition for three years.

Tracelarm messenger bags are simple and easy to handle. A safety key locks the alarm mechanism when the bag is not in use.

Little does the "thug" know that a loud alarm will soon be sounded

To his surprise, gun shots are heard, and a yellow smoke screen appears

Concealed between the handles of the bag is a fine wire cable with a loop that slips over the messenger's forefinger. This cable operates the trigger mechanism within the bag, and its length permits ample free movement.

Should the bag be snatched or taken from the messenger, the loop tightens upon his finger, and the wire pulls away from its connection within the bag. This movement instantly closes the automatic inside lock and also trips the alarm mechanism—without sound.

Ten seconds later the alarm starts. Four detonations in rapid succession are followed immediately by two streams of tracer-smoke, proceeding from outlets in the bottom of the bag. The distinctive yellow smoke is readily visible for a long distance. This smoke is not injurious and does not contain tear gas or obnoxious elements.

Discharge outlets in the bottom of the bag are concealed by a leather cover which comes off when the alarm operates. No damage can occur to the bag or its contents as a result of this discharge, and the bag can be refitted with a new Tracelarm shell.

### ELECTRON

A SINGLE "atom of electricity"—a single electron—can be detected by the "Geiger-Mueller counter." So small is the amount of electricity carried by a single electron that an ordinary 10-watt electric light bulb requires a billion billion of them every second to keep it lit.

## Skin Writing

SKIN writing, an unusual phenomenon, is rare among human beings—so much so, in fact, that those exhibiting this peculiarity hire themselves out, at times, for side shows at circuses.

Dermographia, as skin writing is known technically, is due to a hypersensitive condition of the individual toward some source of irritation. This may be found in the form of a drug or some mechanical agent which induces an urticarial reaction due to friction of the rough object with the superficial layers of the skin.

Producing dermographia

Just as some individuals are sensitive to certain foods or the pollen of various flowers, so is the skin writing person reactive toward pressure or frictional effects. Otherwise the individual is perfectly normal.

A fine example of dermographia

The theory that is held by most authorities for this extraordinary condition is similar to that which explains other idiosyncrasies, namely that of anaphylaxis. This implies that the skin of such individuals manifests hyper-susceptibility to an irritating influence. How this may be relieved, medical science is not yet prepared to state.—*Prof. Victor Lewitus.*

## Flavor From Wood

A CANADIAN paper company is preparing to manufacture vanillin, the flavoring principle of vanilla beans, from sulfite liquor obtained as a by-product in its paper manufacture.—*D. H. K.*

## Artificial Sea Water Test of Concrete

A MINIATURE ocean with artificial sea water and electrically controlled tides is an important part of the equipment in the research laboratory of the Portland Cement Association in Chicago. This Lilliputian ocean was created as a means of studying the effects of continuous exposure of concrete to sea water.

The apparatus includes two 11-foot tanks of concrete, filled with water of the same chemical composition as sea water except that it is four times as concentrated. Electric pumps circulate the water and give the effect of tides. Every 24 hours it's high tide in one tank and low tide in the other. The rise and fall is one foot.

Small reinforced concrete piles of varying quality are placed in the tanks and daily observations made of their behavior. The depth of penetration of the salt water is checked by daily tests with extremely delicate electronic meters.

Each test specimen contains many electrodes in pairs. An electric current of the intensity of one milli-ampere is passed between pairs of these electrodes.

The instrument readings record the amount of resistance to the flow of current in several directions and in various parts of the test specimens. That shows the penetration of the salt water.

The tests will continue for years. The concentration of the water and the longer period of alternate immersion and drying out afforded by the 24-hour tide cycle instead of 12 as in the natural ocean, gives a more severe test than in actual practice.

"Sea walls of concrete have been in service 34 years and more without deterioration," E. C. Shuman, research engineer in charge of these tests says. "In contrast to the rare instances of the disintegration of concrete after long immersion in sea water are many instances of even greater age that show no deterioration. The reason for the greater life is no doubt largely due to the higher quality of concrete used and the better methods of placing and curing. These tests will give us more precise data on the factors which promote a longer life to concrete exposed to sea water."

**LAUNDRY MARKS**

**LAUNDRY marks, invisible by ordinary light, are perfectly legible in the bundle-wrapping room equipped with ultra-violet lamp. The mark fluoresces under light from this lamp.**

## Living Teddy Bear—the Koala

IF the bored little fellow in our illustration—an Australian koala, or native bear—realized what he is up against, he might not be so nonchalant and ho-hum-ish. For like other members of the southern continent's unique and distinctive fauna, he is threatened with extinction as a species. Valued for his fur, pursued recklessly for "sport," he has been shot almost out of existence. One active human friend he has, Noel Burnet, who at his own effort and expense established Koala Park, near Sydney, N. S. W. But funds are lacking to keep up the work of conservation and Australian statesmen see no way of supplying the desperately

Tired?

needed appropriation to take over the park into public ownership. Koalas cannot even be exported from Australia because they will starve if deprived of the leaves of the one eucalyptus species that they feed on. Most regrettably, these little living Teddy Bears would seem to be traveling the unreturning road—"going west."—*Science Service.*

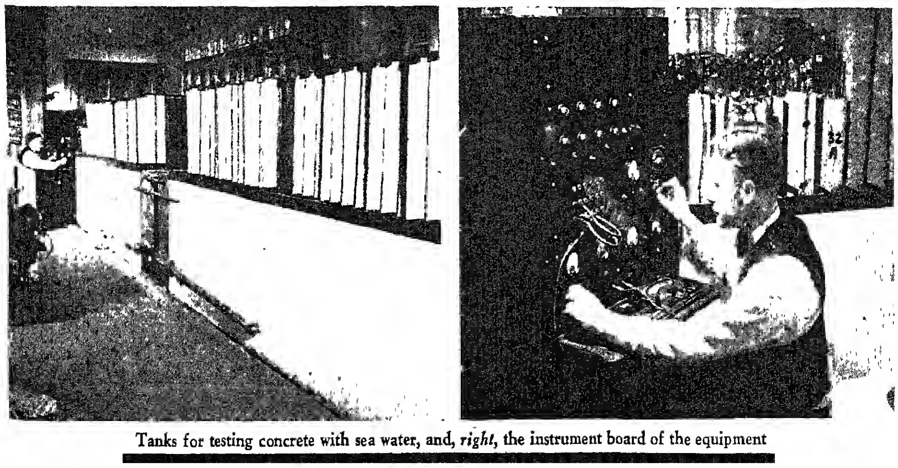
## Iodine in Water, Best Antiseptic for Cuts

THE best antiseptic for treating wounds, cuts and abrasions is a solution of iodine in water. This is the conclusion of Dr. Robert N. Nye of the Mallory Institute of Pathology, Boston City Hospital, who has completed a series of experiments on certain commercial and non-commercial solutions ordinarily used as antiseptics for minor wounds and for irrigations.

Four solutions containing iodine, seven containing mercury, two containing chlorine, and three miscellaneous solutions were tested at the same time. On the 16 antiseptics five comparisons were made: (1) bactericidal activity, (2) bactericidal activity in mixtures containing 50 percent horse serum, (3) diffusibility, (4) toxicity, and (5) cost.

The antiseptics that did not measure up as well as iodine included: Mercurochrome, Hexylresorcinol, Listerine, Pepsodent, Zonite, and others.

The results are given in the *Journal of the*



**Tanks for testing concrete with sea water, and, *right*, the instrument board of the equipment**

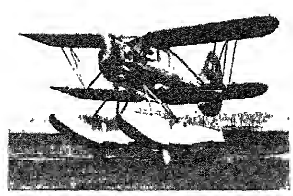
*American Medical Association.* "The superiority of iodine as an in vitro (in a glass) antiseptic is obvious," states Dr. Nye in the medical journal. "The bactericidal strength of any iodine solution is directly proportional to its free iodine content." Iodine was the only antiseptic of the series that retained its bacteria-killing power in the presence of an *equal* amount of serum. It possesses a high degree of penetration and is not unduly toxic for human white blood corpuscles, Dr. Nye declares. In dilutions suitable for their particular purposes it is inexpensive.

Dr. Nye asserts that some opposition to the use of iodine has developed because it is usually employed as the standard (7 percent) or half strength (3.5 percent) tincture. Such a solution is painful to apply and is irritating to the tissues, partly as a result of its high iodine content and partly because of the alcohol. Iodine in a solution of water rather than of alcohol can be used to advantage, he says. A 1 percent or even a 0.5 percent aqueous solution can be used for wounds, cuts, abrasions, and irrigations. *—Science Service.*

## Popularizing Water Flying

THE recent New York Aviation Show was the first held since 1930. Transport planes were too big to take into Grand Central Palace, and war clouds over Europe have so impressed the need for secrecy on our governmental authorities that no new Army or Navy planes were shown. But even without such exhibits the Show proved entirely successful, thousands of people visited the show, there was a constant stream of interesting events—and, what from the point of view of the industry is better still, a large number of airplanes were sold, with checks passed over in payment of deposits right on the floor. In all probability the National Aviation Show will become an annual event, just as is the Automobile Show or the Motor Boat Show. And so it should be.

Not the least benefit of the National Aviation Show was in indicating how water flying could be made more popular. Cities in the United States do not, as a rule, have conveniently located airports. New York City, for example, has to place its main reliance on Newark, New Jersey, to the continued disgust of its worthy Mayor, Fiorello H. La Guardia. But almost every American



A standard Waco biplane fitted with the amphibious float gear described

city, New York included, has a river or a lake front close to its very heart. Therefore, the now widespread practice of building seaplane ramps under municipal auspices is most desirable.

It is also desirable that there should be available machines that can use land or water and can operate in summer or winter. The engineers of Edo Aircraft have made a notable contribution in this regard by the development of an amphibious gear for use in conjunction with a twin float seaplane. The amphibious float gear, exhibited to the public for the first time at the Show, attracted much favorable comment. The gear is shown in the sketch, and in application to a standard Waco biplane in the photographs.

Each of the wheels of the main amphibian landing gear is supported by a pivoted yoke, which connects through a Bendix shock strut to a small crank concealed under the deck of the float. An exposed shaft placed transversely between the two floats is rotated from the pilot's cockpit by a worm gear drive and in turn operates in unison the two cranks placed in the float, turning them through an arc of 190 degrees. Thereby the wheels are retracted wholly within a well in the floats through an aperture in the bottom. Adequate wheel brakes are provided. The wells in which the wheels are carried are made completely airtight so as to provide a "diving bell" effect and to insure that none of the flotation or buoyancy is lost. It will be noted that a secondary step is placed ahead of the wells so as to shield the bottom openings from water interference.

Tests have shown quite definitely that with wheels retracted, or even removed, the machine can be handled successfully as a conventional two-float seaplane. With wheels down ordinary landplane qualities are available.

Space considerations will not permit us to describe the ingenious manner in which the water rudder shown on the right side of the sketch operates, nor how it is brought out of the way for land-plane use. The rear four feet of the float are hinged against a shock absorber; the result is that a large tail wheel for land-plane operation is eliminated and a small roller suffices, placed at the transom, as the extreme rear portion of the float is called. This roller is not shown in the sketch.

The engineers of Edo Aircraft are to be highly complimented on their skilful and simple addition to the possibilities of water flying.—*A. K.*

## "Hindenburg" Sailings

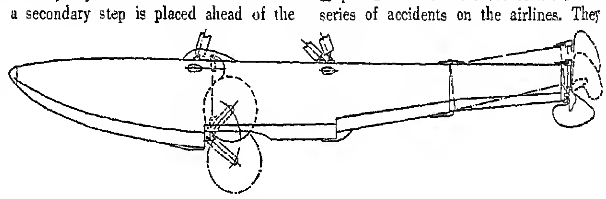
THE German airship *Hindenburg*, shortly to begin her 1937 flights, seems to have settled into a routine of transatlantic crossings that will make air history.

The *Hindenburg's* flights between Frankfort or Friedrichshafen and Lakehurst, New Jersey, will commence with her take-off from Germany on May 3, to be followed by departures on May 11 and 21, June 1, 11, and 22, July 2 and 13, and August 3. The airship will leave Lakehurst on May 6, 14, and 24, June 4, 14, and 25, July 5 and 16, and August 6.

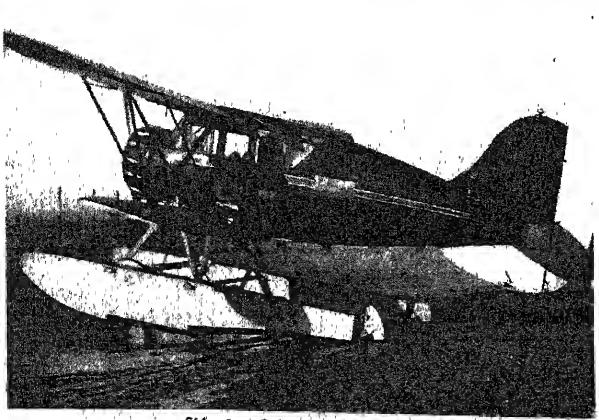
Later flights of the *Hindenburg* will be announced as soon as plans are completed abroad.

## To Lessen the Chance of Transport Accidents

INNUMERABLE theories have been propounded as to the cause of the recent series of accidents on the airlines. They



Drawing of the Edo float gear, showing wheel and rudder positions

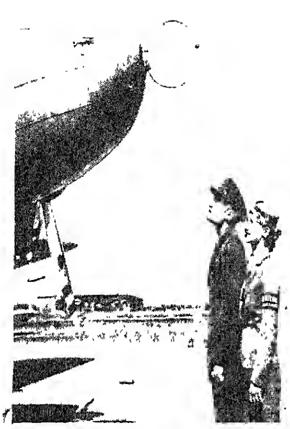


Side view of the amphibious Waco

were not due to a single physical source, nor to a single group or organization of men. We have quite definite theories ourselves as to these accidents, but prefer to leave discussion to the Safety Conference being held, as these notes are written, in Washington, between the operators and the Air Commerce Bureau.

There is, however, one device which should certainly be put into service on every airliner in the country and that is the shielded, static-proof antenna. After two years of research and experimentation the engineers of United Airlines have conquered a weather and radio problem that has annoyed operators since the very first use of plane-to-ground radio communication.

The antenna consists of a circle of copper tube, 1½ feet in diameter, in which are coiled 100 feet of antenna wire—longer



Ring antenna for aircraft

than the standard straight wire antenna commonly carried on the airliners. As shown in the photograph, the anti-static antenna is mounted in the nose of the airplane. The copper tube shields the antenna from snow or rain static, and allows uninterrupted reception of radio beam signals. Further, the small copper tube for static shielding also eliminates the difficulty of "icing-up" encountered with the straight wire antenna.

The new antenna is to be installed on all of the 50 twin-engined transports of United Airlines.—*A. K.*

## A Splendid Amphibian

FOR the private flyer of ample means, there is nothing more satisfying than the ownership of an amphibian of the flying boat type. Types of amphibians for private use are unfortunately few in number and the Fleetwings Sea Bird was welcomed heartily at the recent Aviation Show. Built entirely of corrosion-resisting high-strength stainless steel, the Sea Bird presented a splendid silvery appearance. It is rather surprising that stainless steel has not been widely employed in American airplane construction. If a machine is specially designed for the use of stainless steel, it will give the same strength for a given weight as one designed in aluminum alloy and avoid the labor and annoyance of thousands of rivets. Stainless steel can be electrically spot welded.

The Sea Bird has the fullest modern equipment, splendid accommodation for four occupants, and with its 52 gallons of gasoline (carried in seamless, welded tanks of stainless steel placed in the wings) provides a range of 450 miles. The gross weight is 3450 pounds and the weight empty is 2320 pounds, which is low for an aircraft of this size and type. With a 258 horsepower Jacobs engine, the Sea Bird has a top speed of 150 miles per hour, and can be operated as a flying boat or as a land plane with equal ease. The excellent performance of the ship is in part due to the excellent aerodynamic design, but the hydraulically operated retractable landing gear contributes to the efficiency. When the struts are raised they disappear completely within recesses in the hull; only the wheels remain as partial protrusions, and these are so covered by fairing that they themselves contribute to the lift.—*A. K.*

## Do Pilots Fake Position?

AMONG other points of importance discussed at the Washington Air Transport Safety conference were the two questions: Are pilots forced to "go through," whatever the weather? Do pilots disobey orders and fake positions?

In answer to the first question, only one case of a pilot being over-ruled was demonstrated in the whole history of air transport.

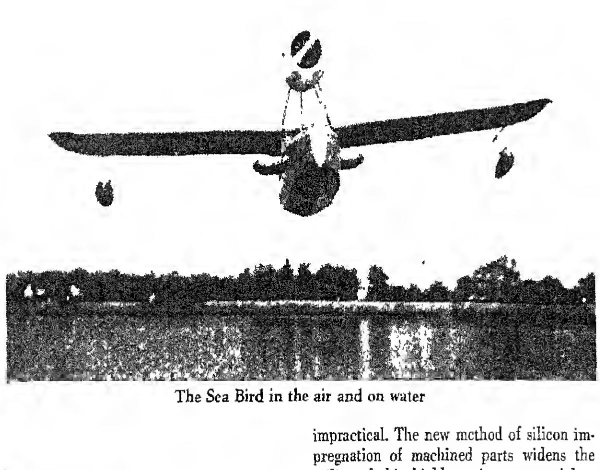
The question of "position faking" by pilots was not so easily dealt with. To meet this problem a new instrument will be put into service to make pilots "altitude conscious" and to check whether they really fly at prescribed altitudes in foggy weather, or whether when they see a break in the fog they come down to dangerously low levels.

This instrument, known as a "flight recorder" and weighing scarcely more than a pound, will be suspended in the baggage compartment or some other convenient part of the airliner and be set in operation at the beginning of each flight. One stylus will trace in ink on a flat card the height maintained at all times for a period of 8 hours. In this respect the instrument is really a barograph or recording altimeter. Another stylus will be connected with the plane's radio-beacon receiver, recording when and for how long the radio beam is used.

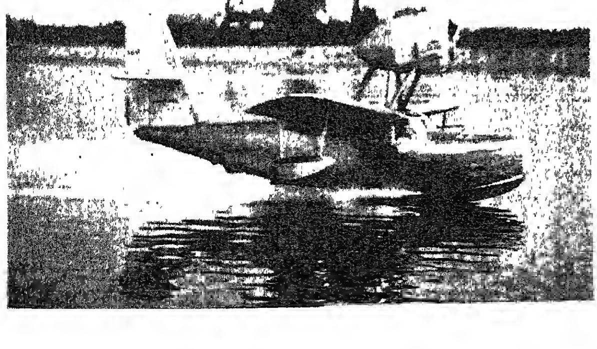
Thus the "flight recorder" will be an infallible check on the pilot's position at all times, both as regards altitude and route. It should be a great aid to safety.—*A. K.*

## Silicon Impregnation of Steel

A NEW process gives high acid resistance to iron or steel parts by impregnating their surfaces with silicon. The operation is somewhat similar to the case-hardening of steel by carbon, but the result is a case containing as much as 14 percent silicon which is highly resistant to corrosion by acids. Finished parts are treated and show a change of dimension of the order of only one or two thousandths of an inch. High-silicon steels and irons are much used for their extraordinary resistance to acid corrosion. Because of their extreme hardness, these alloys have had to be cast in final form since machining has been impractical. The new method of silicon impregnation of machined parts widens the utility of this highly resistant material.—*D. H. K.*



The Sea Bird in the air and on water



## Condor Following the Dodo?

TO keep the giant California condor from the same fate that befell the dodo, the passenger pigeon, the great auk, and the heath hen, Forest Service officials of the United States Department of Agriculture are trying to preserve the last retreat of this bird.

Frequently seen circling the craggy peaks of California's mountain ranges not so many years ago, the giant bird gradually has re-

treated until its only known habitat now is in the Los Padres National Forest of California.

The National Association of Audubon Societies assisted the Forest Service last year in gathering information about the big bird and its habits. In a recent report to the societies, Cyril S. Robinson, Associate Forester, said that "the bird is so constituted as to be handicapped by the very factors that make for its magnificent importance.

"Its size," he declared, "calls for space and easily accessible landing places. The peculiar conditions that must make up its permanent place of abode, and the fact that it returns to the same place to nest and roost year after year, are a few reasons that make it so important that the situation does not change for the worse."

The condor has diminished largely because of its eating habits, Mr. Robinson avers. It lives upon carrion, particularly the flesh of large animals. Back in the days when a cowhide was worth more than a carcass, the condor was supplied with plenty of food. More recently food conditions have become a problem.

The Forest Service is planning to provide undisturbed roosting and nesting places which will have an elevation sufficient to provide timber, and opportunities for bathing and drinking. The study indicated that complete isolation and proper protection from forest fires and invasion of people are necessary if the condor is to survive.

## TRANSPORTATION SECTION

### Why Not Long Ago?

Among other improvements in automobiles this year is one which seems so obvious that it is strange manufacturers did not adopt it long ago. This is the wider front seat, which has been offered by practically all makers this year. The accompanying photograph, from the manufacturer of Hudson and Terraplane cars, boasts a 55-inch front seat, the demonstrator showing this by means of a "yard" stick of that length.

Gratuitous advice is seldom welcome. However, we cannot resist the temptation to emphasize by repetition the fact that this is an obvious improvement. As a matter of fact, there seems no good reason why seats cannot be even wider than they are at present, for, in our humble opinion, the outside running board is a more or less useless appendage. Cars could easily be designed—as some have been in the past—with the front doors meeting the edge of the running board flush and with the necessary step-up inside the door. Surely the designers could make this change appear fully as artistic as anything being built today.—*Editor.*

Width for comfort

### A Correction

An error in the original typing of Mr. J. J. Pelley's article, "Progress on Rails," in our February issue, inadvertently slipped past the editors despite the fact that Mr. Pelley wrote us in plenty of time requesting the correction. We sincerely regret the fact that this went through in incorrect form.

In Mr. Pelley's article, on page 82, line 13, the statement was made that ". . . for each ton of coal consumed in freight service, the railroads hauled 8⅓ gross tons one mile." The word "pound" should have been substituted for "ton" so that the statement would read ". . . for each *pound* . . ."

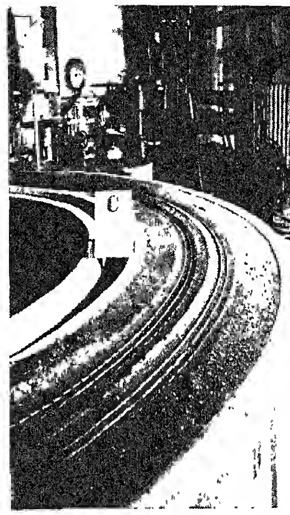
### 'Round and 'Round

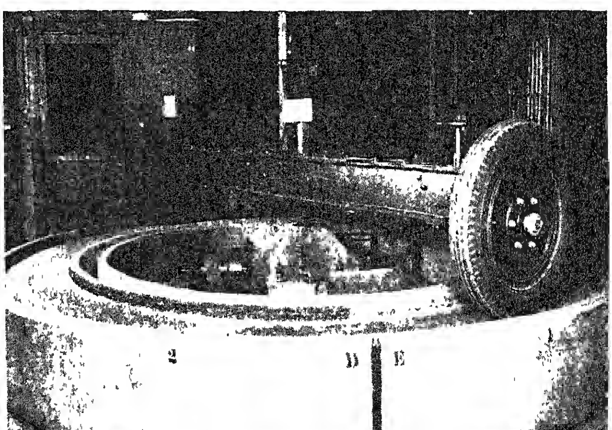
The popular belief that you never get anywhere going around in circles is being disproved at the Arlington testing laboratories of the United States Bureau of Public Roads, where two automobile wheels rotating on the surface of a small circular track are revealing the relative stabilities of various low-cost road surfaces. There are two of these set-ups, one indoors and the other out, with five or six sections of different bituminous mixtures making up the surface over which the wheels rotate.

Tests are made of one variable factor at a time, such as the quantity or the consistency of the bituminous mixture, and are run until the relative wear on each section reveals the comparative stabilities which result with regard to the several circumstances of the variable. The wheels, which exert a force of 800 pounds on the road surface, are mounted on the ends of a centrally pivoted steel beam which can be driven at three speeds, the maximum being nine miles per hour.

The track itself, laid in a concrete trough, is approximately 37 feet in circumference, 18 inches wide, and has a mean depth of 12½ inches. Distribution of the "traffic" over the width of the surface during compaction is made possible by shifting the pivotal point of the steel beam back and forth by means of a hand-operated wheel, or, in order to accelerate the tests by simulating conditions of high traffic density, the pivotal point may be set off center so that the wheels travel in two concentric lanes five inches apart.

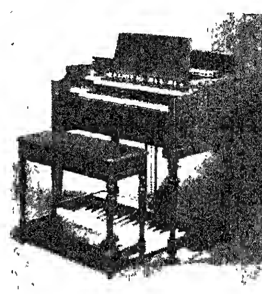
The surfaces may be tested dry or flooded, or the subgrade, which consists of gravel or crushed stone, may be kept moist by the capillary introduction of water through the





The wheels go 'round and 'round, testing low-cost road surfaces in the laboratory of the Bureau of Public Roads. *Above:* A part of the track, showing wear

# A new kingdom of music *for you who play the piano.* A concert organ for the home



FITS IN A FOUR-FOOT SQUARE

*Originating tones by electrical impulses, the Hammond Organ requires no pipes nor reeds. The spinet-like console and the bench occupy only a four-foot square in your living room. The tone cabinet can be placed anywhere. The Hammond can be carried easily by two men and is installed by merely connecting it to an ordinary electric outlet.*

IF YOU play the piano even a little, the Hammond Organ opens for you a veritable new wonderland of music. For on the Hammond the touch of your finger summons forth not just a single tone color, but an infinite variety of lovely organ voices.

At the keyboard of this remarkable instrument, you give your favorite melodies new, exquisite depth and richness. The simplest tunes are inspiring to you—thrilling to those who listen.

All the varied voices of the organ—strings, reeds, diapasons—are at your command. You shift from one to another to suit your mood.

And this new kingdom of organ music is now for the first time within the reach of families of average income. Producing the full tone range of the concert organ, the Hammond costs no more than a fine piano, fits into any living room.

See and hear the Hammond Organ at the showrooms of any of our dealers—each one the leading musical merchant of his community. You will find an organist glad to play for you. He will demonstrate to you, also, how easily the Hammond can be played by *anyone* who knows the piano. Consult your telephone directory . . . or write to The Hammond Organ, 2943 N. Western Ave., Chicago.

*Nearly 1000 churches use the Hammond... it is an appropriate donation for your church*

# THE HAMMOND ORGAN

$1250 and up f.o.b. Chicago —slightly higher for large installations

TODAY, LESS THAN TWO YEARS AFTER ITS INTRODUCTION, THE HAMMOND IS THE LARGEST-SELLING ORGAN IN THE WORLD

lower part of the inner wall of the track.

From the effects produced on the test specimens by these revolving wheels, which travel about 8000 miles per year, engineering improvements are being developed which the motorist will realize in the construction of better highways.

## "PAINTING" A BRIDGE WITH METAL

THE problem of protecting steel bridges against brine drippings has increased steadily since refrigerator cars were first placed in service until today it is one of the major maintenance problems on many railroads. A recent issue of *The Metallizer* makes this comment in discussing a report of Mr. B. R. Meyers, Asst. Gen. Bridge Inspector of the Chicago and Northwestern Railroad. On roads carrying heavy volumes of such traffic, track fastenings are destroyed in half the normal life secured elsewhere, while the damage on bridges is illustrated by the fact that a single road is now completing a program of bridge repair and renewal involving the expenditure of more than 1,000,000 dollars, made necessary solely by this form of corrosion on a limited mileage of its systems.

Mr. Meyers mentions in his report certain tests of metallizing which were carried out on a Canadian railway where one girder of a deck plate girder span was metallized and the other was spray-painted. Metallizing, as most of our readers know, consists of spraying molten metal onto a surface, the metal, in the form of wire, being fed automatically into a reducing flame where it is melted, atomized, and projected onto a surface by means of a suitable air blast.

Using as an example the expenditures on the special test job mentioned, Mr. Meyers says he believes that metallizing appears to have merit. The initial cost of metallizing is high, as a very thorough job of sand blasting is necessary for a proper bond. On an annual-cost basis, however, it can be compared with other types of protection, as it is expected that under severe conditions it will give protection for 20 to 25 years. One of the many advantages of metallizing is that, regardless of the thickness of the coat required, it can be applied at one time. Thus the injurious effect of water or cinders falling on fresh paint or of dragging ties back into place before paint is dry is eliminated.

A tabulation of the cost in the test shows that including labor, sand blasting and materials for painting the entire structure with three coats of paint totals 17 cents per square foot; metallizing the brine sections only with .009 inch zinc coat, 55 cents a square foot; and metallizing the entire structure with .003 inch zinc coat, 43 cents per square foot.

**Installed on the Union Pacific's crack train "Challenger," this electric water cooler by General Electric does away with the old method of icing drinking water. No longer need porters bring in chunks of ice, of doubtful purity and cleanliness, and put it in or around tanks of drinking water. Foot pedal operation adds to passenger convenience**

## RAILROAD CROSSING BUMP-STOP

THE problem of providing automatic stops for railroad grade crossings to prevent crashes between automobiles and trains has long occupied the attention of engineers and designers. Many ingenious mechanisms have been produced, but most of these in the past have lacked adaptability in certain respects. A new one, announced by the Evans Products Company, does a positive job of notifying the driver of the oncoming automobile that a train is due at the crossing.

This device consists of a hollow framework of cast steel sunk into and across the highway. It is hinged so that, upon the approach of a train, it swings up into the roadway to present a barrier 9½ inches high on the road surface. Should the automobile driver fail to notice the lights that are set against him and the "stop" sign on the barrier itself, he bumps into this barrier with such force that he cannot fail to be warned.

The "Auto-Stop" is mounted on hinges in a reinforced concrete pit with the top of the lid normally flush with the road surface. The drive mechanism, off to one side, consists of a motor, a brake, a circuit controller, and a gear reducer, mounted in a box-like frame of angle bars. A standard red and green traffic light is placed beside the Auto-Stop. The green light burns as long as the crossing is safe, but when a train enters the control limits the red light comes on. Three seconds later the Auto-Stop starts to rise, hesitates for 10 seconds at a height of 4 inches, during which time the lid is easily depressed if the car should continue over it. At the expiration of the 10-second warning interval, the device rises to a height 9½ inches above the roadway and locks at this point. It remains in this position until the train has passed.

**A "bump-stop" signal, automatically operated, for railroad crossings**

## MORE EFFICIENT LOCOMOTIVES

(*Continued from page* 225)

and by a streamlined Pennsylvania Railroad locomotive built for similar service. Both are standard Pacific type locomotives and are fully shrouded. These high-speed trains have thus far been extraordinarily popular and are apparently profitable. Whether in the long run their motive power will be Diesel engines or steam locomotives remains to be seen. There is a limit to their number for, taking all factors into consideration, it seems probable that only about one tenth of the mileage of the country is now suitable for such high-speed operation.

## CUNARD LINER OF 30,000 TONS

A CONTRACT for the construction of a new intermediate-size transatlantic ship is now being negotiated, it was confirmed recently by the Cunard White Star Line in answer to inquiries. This ship is destined for the company's service to Channel ports.

The new ship will have a gross tonnage of about 30,000, somewhat in excess of the 27,000 of the *Georgic* and *Britannic*. She will be built by Cammell, Laird and Company of Birkenhead, near Liverpool, England. She will carry cabin, tourist, and third-class passengers and will have a capacity of 500 in each class.

Capable of maintaining a speed of about 23 knots, the new ship will really be a new type, with size and speed between that of the superliner *Queen Mary* and the *Georgic*. Crossings by the new ship will take five and one-half to six days as compared with the usual four and one-half days for the *Queen Mary* and seven days for the *Georgic*.

The gradual all-around increase in the

size of ships is illustrated by the fact that the *Mauretania*, which went into service first in 1907, 30 years ago, had a gross tonnage of only 30,000. This famous speed queen, which held the laurels for the transatlantic crossing until 1929, was the largest as well as the fastest ship of her early years.

The present holder of the Blue Ribbon for the fastest transatlantic passage, the *Queen Mary*, has a gross tonnage of 80,773. A sister-ship for the *Queen Mary*, of about the same size and speed, is already under construction in the Clydeside shipyards of John Brown & Company. The keel for this superliner was recently laid and she is known for the present simply as *No. 552.*

## "Pigs is Pigs"

COYOTES have become such a pest that ranchers near Kemmerer, Wyoming, are using specially trained hounds to trail them to their dens. But trailer hounds are hard to get and Newt Sims, rancher of Fontenelle, is highly pleased that he has seven instead of only the male and female that he had ordered from Evening Shade, Arkansas, recently.

There might not have been such a happy ending to the story except for the versatility of Bill Gilchrist, night depot agent of the Railway Express Agency. In handling a widely varied traffic the expressman has to be prepared for all sorts of emergencies. However, on such occurrences he can not help but be embarrassed.

For when No. 21 pulled in one evening, he unloaded the big crates containing Mr. Sims' hounds from the train on his truck and went about his work. The stage that was to take them into the mountains was due soon.

When Gilchrist looked again, he was staggered. There were not just two but seven trailer hounds in that crate. Five little puppies were whimpering around the mother dog. The record doesn't show whether Gilchrist had ever heard of Ellis Parker Butler's "Pigs is Pigs," but he did realize that such an event required some pretty expert work. The hound family was transferred to the warmth of the express depot and the stage left without them that night.

The stage driver told the rancher of his good luck and early the next morning he drove in to receive and care for the family. The youngsters were all healthy specimens and Mr. Sims is confident that ultimately they will play a big part in the decimation of the coyote population in his section of Wyoming.

## Australian Roads Are Machine-Baked

FOR several years the Queensland (Australia) Main Roads Commission has been experimenting with a machine invented by L. H. R. Irvine, a Sydney engineer, for baking the surface of formed-up clay and black soil roads. The machine is really a traveling furnace, the heat of which, as the machine moves over the surface of the road, bakes the soil and converts it into a suitable and lasting pavement. The experiments, which have been conducted in the Toowoomba district, have proved so successful that the Commission has purchased a new and larger machine for baking roads throughout the extensive

black soil regions of Western Queensland. The new machine, which embodies many improvements on the experimental model, will weigh when in operation about 27 tons. It is 30 feet long and is able to bake the soil at the rate of approximately 60 feet an hour. Its operating heat is about 1200 degrees, Fahrenheit.—*Australian Press Bureau.*

## Biggest Accident Risk for Front Seat Passenger

THE girl in the front seat runs the big risk in motor accidents.

Seventy-five percent of the severe, crushing, facial injuries sustained in automobile accidents occur to the person riding beside the driver, in the experience of Dr. Claire L. Straith, Detroit plastic surgeon, *Science Service* reports. The majority of these victims are young women.

Lacking the support of the steering wheel, which often saves the driver, the guest-passenger is thrown forward more violently at the impact. The passenger's head strikes the instrument board, where projecting handles, knobs, and cranks add to the hazard. Elimination of projecting objects from the passenger's side of the instrument panel should be attempted by motor car engineers, Dr. Straith declares in an article on facial injuries caused by motor accidents, which appears in the *Journal of the American Medical Association.* (Our January article shows that this has already been done to a large extent.)

The use of "crash padding" on the instrument panel might do much to minimize the seriousness and extent of this type of injury, believes Dr. Straith.

Facial disfigurements resulting from such accidents often cause psychologic handicaps that ruin social and business careers, the Detroit surgeon states. He says: "The ranks of the unemployed and unemployable are already large enough without adding to their numbers persons physically and mentally handicapped by preventable or curable facial defects."

The plastic surgeon cannot expect good results in face injuries unless the first aid treatment has been carefully done, asserts Dr. Straith. Plastic procedures, such as correcting scars, crushed facial bones or lost eyebrows, ears and nose, should not be undertaken until two months after every trace of infection has disappeared. He tells physicians how he replaces severed noses, using skin grafts from the forehead of a woman patient and from below the ear of a man patient.

## Ready But Nowhere to Go

LIKE a man in the death house awaiting delayed execution while lawyers wrangle over appeals, new trials and other matters, is the S. S. *Leviathan* of the United States Lines, lying at its pier at Hoboken, New Jersey, just across the Hudson River from Manhattan's towering skyscrapers.

The former German liner *Vaterland*—part of this country's visible gain from the World War—has been out of service for many months because it failed to compete with the faster blue ribbon liners of the Italian, French, and German governments. Plenty of bulk but lack of speed laid up the *Leviathan.*

The United States Maritime Commission permitted the operating company of the *Leviathan* to take the liner out of service only on condition that it be kept in good repair until such time as a replacement liner could be built. That time is now drawing near.

Two alternative designs for new ships have just been submitted to the Maritime Commission. One calls for a modernized sister-ship of the liners *Manhattan* and *Washington*, now in service. The other calls for a slightly larger liner now known simply as a "K" ship for identification purposes. Naval and Maritime Commission ship's architects and engineers are now studying the plans of the proposed additions to A ca's merchant marine.

Although the maintenance of the *L than* expired recently, by agreement United States Lines have been notified they will be expected to continue the repair" condition until the final dispo of the out-moded liner is decided.

The Maritime Commission is now tryin to turn over its commercial marine whit elephant to the War or Navy Department as a possible national defense auxiliary, trying to see if the *Leviathan* can be laid u later in some navy yard or war terminal a a reserve ship.—*Science Service.*

*(End of Transportation Section)*

## Synthetic Musical Instruments

WIDE attention is being given by musicians to a violin made of a glass-clear synthetic resin of the acrylate type. This violin, which was assembled by cementing together parts made of the resin in very much the same way that the wood parts of the ordinary violins are assembled, possesses a remarkably clear tone. It has been compared with some of the finest violins but does not possess the strength of tone of the best. Flutes have also been machined from the same resin and it is not improbable that whole orchestras may some day be equipped with transparent instruments of this kind.—*D. H. K.*

## Seaweed Tablets No Good in 30 Different Ways

CURE-ALLS are still offered to the ailing. They do not appear so frequently as in the more gullible past, but now and then a particularly offensive one appears, says the Food and Drug Administration.

Recently a case was terminated and fines imposed against John Lee Clarke and William J. A. Bailey of New York, proprietors of the Lee Kelpodine Co., Inc., manufacturers of "Kelpodine Tablets." The tablets were made of compressed seaweed or kelp and were fraudulently offered for the treatment of 32 specific diseases and "other conditions." In this amazing list were included common and general conditions and some of the most stubborn diseases known to the human race. The complete

to for which these fakers recommended ir seaweed products is as follows: pyrea, headache, indigestion, tuberculosis, cer of the liver, glandular trouble, vousness, dental caries, underweight, aemia, constipation, general weakness, melancholia, digestive disturbances, asthma, rickets, bone diseases, chlorosis, eczema, stomach disorders, nervous break-down, migraine, high blood pressure, stomach ulcers, hayfever, liver congestion, subnormal growth, mental exhaustion, neurasthenia, rheumatism, arthritis, obesity, and other conditions.

## Dusty Refuse Dangerous

IF an apartment-house housewife dumps dusty refuse into an incinerator chute when there is a fire in the box at the bottom, she is likely to get the surprise of her life and will be lucky if she escapes injury. Dr. David J. Price, chemical engineer of the United States Bureau of Chemistry and Soils, who has made many reports on dust-explosion hazards on the farm and in industry, now calls attention to this hazard in the home.

Many instances where such explosions have occurred are on record, as this type of incinerator is common in apartment houses. One such explosion took place when a woman, having started to bake a cake and found the flour to be wormy, decided to dispose of the mixture of flour and sugar. She dumped the mixture down the incinerator chute and closed the hopper door. An explosion followed that blew open the door, burned the woman seriously and damaged property throughout the building close to the incinerator inlets.

This type of explosion, Dr. Price explains, is similar to the more publicized industrial disasters which have occurred in flour and starch mills and grain-milling plants. In some of them there has been a heavy loss of life as well as of property.

Other domestic incinerator explosions have happened when the dust bag of an ordinary vacuum cleaner or dust from a floor-sanding machine was dumped into the incinerator. In this way fine dust particles are left suspended in the air all the way down to the bottom of the chute. This dust burns so quickly in the limited space that the pressure forces fire and gases through the incinerator doors and vents.

To prevent such explosions, Dr. Price says, all dry dust should be wetted thoroughly and placed in a strong paper bag or carton—one that will not burst in falling down the chute.

## Synthetic Rubber Aids Natural Product

A NEW use for the synthetic rubber, Thiokol, has been found in its favorable effect on the vulcanization of natural rubber. Used in connection with thiuram vulcanization accelerators, a small quantity of this synthetic rubber increases the speed of cure of natural rubber.

The vulcanization process as applied to rubber consists of heating the mixture of rubber and sulfur until chemical combination occurs between the two. Numerous additional agents, called accelerators, improve the

finished rubber by shortening the hea[t] period or reducing the temperature ne[ces]sary for the treatment. Apparently Thiol which is a compound of sulfur with chl[ori]nated organic compounds, materially assi[sts] this operation.—*D. H. K.*

### Scale

A NEAT little scale enclosed in a red mottled Bakelite molded housing has just been imported from Germany. The new design represents a combination letter

New scale with extra trays

scale and ordinary household scale with a weighing range of 11 pounds. For kitchen use a tumbler top is provided with graduations indicating liquid measurements.

### In the Interests of Science and Public Safety

THE greatest part of the damage done in the average earthquake is not a necessary result of the earthquake, but is due to our ignorance or indifference. Although it is now known how to build securely against ordinary earthquakes, this knowledge is not sufficiently disseminated. It should be in the hands of all engineers, architects, contractors, and property owners. It would be valuable also to the rest of us, especially to those whose children may be exposed to danger from falling chimneys, cornices, or walls at school.

The effective way to help in the increase and dissemination of knowledge about earthquakes, and to be fully informed on the subject, is to join the Seismological Society of America, its Eastern Section, or both. Membership is open to everyone interested in the subject. Dues in the Society are low, and include subscription to the quarterly *Bulletin*, which contains the results of research and articles of general interest on earthquakes.

### Glycerin as a Stain Remover

GLYCERIN applied warm to stains made by mustard, coffee, cocoa, and so on, on delicately colored fabrics is efficient in removing them without damaging the color or the fabric. After application it is allowed to stand for a few minutes and then rinsed off with water.

For removing grease and other stains, [a] cleaner made by mixing glycerin (1 ounce), alcohol (1 ounce), ether (1 ounce), am[monia] (4 ounces), and castile soap (

to make two quarts, has been recommended.

Rust and ink spots can be removed by using a solution of two ounces of potassium binoxalate in 88 ounces of water, to which 1½ ounces of glycerin have been added. In use, the rust or ink spot is moistened with this solution and rinsed out carefully after three hours. Lipstick stains are said to yield to a mixture of glycerin (1 part), glacial acetic acid (1 part), and methyl alcohol (3 parts). Although this is not unfailing, it is said to be highly efficient.—*D. H. K.*

## Alcohol

PERHAPS the best definition of what constitutes a temperate use of alcoholic beverages is the amount that can be taken by the individual without obvious deleterious effect. Because individuals differ so much to begin with, and because the amount of alcohol tolerated by the habituated person is so different from that which can be taken by the abstainer, it is impossible to say what can be taken safely by the average person. As every one knows, there are thousands of men and women who are made dizzy and uncomfortable by two cocktails, and then again there are persons who can drink a quart of whisky in an evening without showing any sign of alcoholism.

It is hard to say also how much alcohol the average person can safely utilize as food. As Mitchell has shown in his excellent analysis of this phase of the subject, the energy of alcohol is to a large extent available to the body. When added to a complete diet, alcohol induces a greater retention of nitrogen as well as of fat. As compared with a similar supplement of sugar, the energy of an alcoholic supplement is only about three fourths as available, probably because of a greater specific dynamic effect. Its growth-promoting power is definitely less than that of sugar. These conclusions were based on experiments on rats.

The effects on the brain of drinking much dilute alcohol can be the same as those of taking a small amount of the concentrated drug. The degree of intoxication seems to be related to the amount of alcohol in the blood and probably to its rate of accumulation in the body.

Water taken with alcohol was found to stimulate its absorption and to cause a more rapid and intense intoxication, but also a quicker recovery. Milk taken with alcohol seemed to be the most effective food in inhibiting intoxication.

It is not yet clear why some persons can tolerate more alcohol than others. Cushny quotes Pringsheim, who showed that part of the greater tolerance of the habituated person is due to an increased ability of the tissues to oxidize the drug. In addition, the sensitiveness of the brain must be altered, because Sweisheimer found that a given concentration of alcohol in the blood induces greater intoxication in an abstainer than in an habitual drinker. Some students of the subject believe that the tolerant person absorbs less of the alcohol. It may be also that in tolerant persons the liver is able to handle a greater amount of the drug in a given time.

That the oxidative demands of the muscles play an important part in removing alcohol from the circulation was shown in the case of a physician whose boat capsized far out in an exceedingly cold lake. When he

(*Please turn to page 266*)

# THE AMATEUR TELESCOPE MAKER

Conducted by **ALBERT G. INGALLS**

LAST month this department contained the bare statement—as much as was then known—that Rev. W. F. A. Ellison, author of the main portion of the book "Amateur Telescope Making" and preceptor of thousands of amateur followers of the telescope-making hobby, had died, and expressed the hope that further details would soon become available. To such details we now devote most of the available space in this number.

The following communication has now been received from M. A. Ellison, his son, of Knockamel, Sheeplands Lane, Sherborne, Dorset, England:

"You and other members of the American telescope-making fraternity will hear with regret of the death of my father, W. F. A. Ellison, Astronomer and Director of Armagh Observatory, N. Ireland. At the age of 72, he had undergone a severe operation. He collapsed suddenly and unexpectedly on December 31, last, at a time when he was making a splendid recovery and was hoping to resume his duties at Armagh before long.

"I am glad to say that, up to November, last, he had been most healthy and active. One of the last things he undertook at Armagh was a large and most successful repair job to the 18" Calver reflector. He had also been a member of one of the expeditions to Greece to observe the total eclipse of the sun on June 19, last. He stayed with me at my home in Dorset just after that and was in fine fettle.

"You will remember that I am the youth you met at Armagh during your visit there in 1928. I am now Head of the Army Side at Sherborne School, and run a private observatory here. My father has left to me most of his optical stock and instruments. Some of these will come in useful for constructive work connected with a spectrohelioscope I am building.

"I think I may say that my father valued most highly your friendship and the contacts he was able to make, through you, with amateur telescope makers in all parts of the United States. In his latter years, it was a constant source of pleasure to him to know that he had been able to help so many American amateurs by means of the Scientific American book and in other ways.

"I am enclosing some facts about my father's life."

Mr. Ellison's account follows:

WILLIAM FREDERICK ARCHDALL ELLISON, eldest son of Humphrey Eakins Ellison, Dean of Ferns, and Letitia Archdall, was born in 1864.

He was educated by his father, and entered Trinity College, Dublin, with a Sizarship in Classics in 1883. His father was a man of unusual scholarship and tutorial ability. This is abundantly evident from the fact that William and his five brothers, coached by their father, all gained entrance scholarships to Trinity College, surely a unique record for any university.

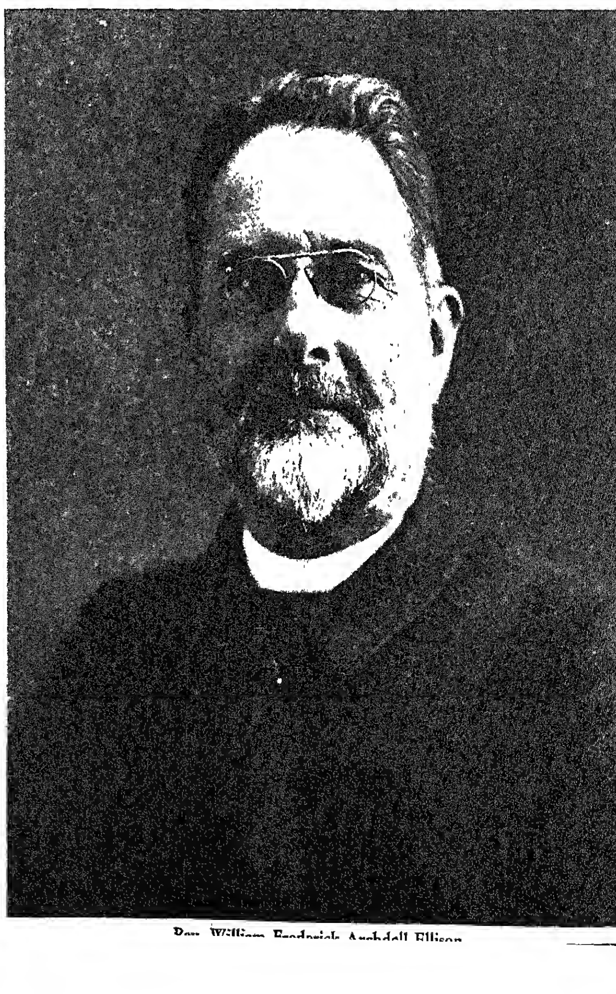
1886, and in the next year graduated with Junior Moderatorships in Classics and Experimental Science. He took his Divinity Testimonium in 1890. Four years later he took his M.A. and B.D. degrees, and in 1895 he won the Elrington Theological Prize.

He was ordained by Bishop Westcott for the diocese of Durham in 1890, and he held successively the curacies of Tudhoe and the Venerable Bede's, Monkwearmouth. In 1899 he returned to Ireland as Secretary of the Sunday School Society, a post which he retained until 1902, when he became Incumbent of Monart, Enniscorthy. Six years later he became Rector of Fethard with Tintern.

It was at Fethard-on-Sea, Wexford, that his first observatory and optical workshops were constructed. Telescope making and observing soon came to occupy all his leisure time, and it was then that he commenced that wide correspondence with astronomers, amateur and professional, all over the world, which he continued actively until the end of his life. In this he was greatly assisted by a remarkable command of foreign languages, writing to his correspondents, whenever possible, in their own tongue.

From Fethard also began that steady stream of telescope mirrors and lenses which were celebrated for the excellence of their figures as well as the quality of their practical performance. In the course of his 30 years of optical work he introduced many improvements to the existing technique for the grinding and polishing of parabolic mirrors. This long experience was made available to his fellow-workers in his book "The Amateur's Telescope", and in the Scientific American publication "Amateur Telescope Making." His life was spent, as he said himself, in helping lame dogs over stiles.

His skill at mirror making was developed at the beginning of the present century in close collaboration with Dr. Nathaniel Alcock of Dublin and later Professor of Physiology in McGill University, Montreal. Out of this friendship the infant art grew rapidly, so that by the end of his life Ellison had 142 lenses and mirrors to his credit, while he must have tested and re-



Rev. William Frederick Archdall Ellison

figured very many more at various times.

He was appointed Director of Armagh Observatory in 1918. He brought with him to Armagh his 18" Calver reflector, which he later presented to the Observatory so that it should find a permanent home. This fine instrument was constructed originally for Colonel Tupman, a well-known English amateur. It was acquired from him by the late John Pierce of Wexford, industrialist, in exchange for a steam yacht. Pierce soon found that the difficulties of erecting an observatory to house such an instrument were much greater than he had anticipated, and soon the telescope became such a white elephant that he was glad to make a present of it to Ellison at Fethard. The latter immediately planned and built with his own hands a light Ruberoid dome, much more suitable for housing an instrument of this type than the massive construction which Pierce had projected. Having refigured the mirror, which proved to be rather too much under-corrected, he used the instrument for observations of Mars and other planets.

At Armagh he also kept up his clerical work, being Incumbent of Kildarton and Canon and Prebendary of Ballymore, Armagh Cathedral.

Canon Ellison married first in 1895, Elizabeth Havelock, daughter of Joseph J. G. Blackburn and grand-niece of Gen. Sir Henry Havelock of Lucknow. By her he had three sons, the eldest of whom was killed in the Great War. He married secondly Kathleen, daughter of the late F. R. Sproule of Dublin, in 1934.

He is survived by his widow and two sons, Henry Havelock Ellison of Elstree, and Mervyn Archdall Ellison, Sherborne School, Dorset.

The late Canon Ellison was a noted Hebrew scholar. His translations of the Psalms from original sources and other works were well-known to the clergy of the Church of Ireland. He possessed, in addition, a phenomenal memory which made him a delightful companion to all who knew him and were privileged to draw upon his wide store of knowledge.

He was a Fellow of the Royal Astronomical Society, a Fellow of the Royal Meteorological Society, Member of the Royal Irish Academy, Member of the British Astronomical Association, Membre de la Société Astronomique de France and a Contributing Editor of Scientific American.

—*M. A. E.*

IN his letter Mr. M. A. Ellison mentioned this writer's visit at Armagh Observatory, in 1928, and possibly a few homely impressions of that brief visit will add to the human side of the picture. Armagh lies two hours inland from Belfast by train through rolling country as green as song and story make the Emerald Isle. Never having seen either Ellison or a photograph of him, the problem of identifying him at the Armagh railway station was a matter of looking for a man who would be looking for a man. A sudden pause was made to study an unusually arresting figure standing in a doorway—a large-framed man dressed wholly in black and with a black beard, the whole giving at first the impression of an immense Spaniard. This proved to be Ellison, who was swarthy in appearance.

A short mile was traversed in the side

car of his motorcycle, ending in the passage of a gateway and the ascent of a hill 100 feet high covering several acres—Armagh Observatory and its grounds. Atop this hill stood the group of fine old stone buildings shown below from the north, also from the west in "A.T.M.", page 359, and surrounded not, as incorrectly stated there, by boxwood trees but by large yew trees—the sturdy timber from which crossbows were made in days of yore.

The place was a veritable museum. Built in 1791, it had for generations accumulated what would elsewhere be regarded as museum pieces. The residential part contained some fine old furniture about which it was felt that a connoisseur of such things would go into ecstasies. Ellison opened a box, revealing one of those old brass-mounted Newtonian-Cassegrainian-Gregorians made by Short and once owned by King George III—the ruler with whom we Americans once had a slight difference of viewpoint. Possibly few know that this monarch was an excellent amateur astronomer, but he knew the stars too well and the British Colonies of his day too ill. Except in jokes, however, all that is forgotten when one visits the British countries.

Ellison's shop contained but little to look at—which is equally true of most optical experts' shops; in fact, the amateur's shop is likely to display more fixings than the professional's, an optician's mainstay being what is under his hat and in his fingers. After some weeks of separation from a whetstone the writer's jack-knife had become dulled, and Ellison at once volunteered to restore its razor edge, and his manner of handling it on his whetstone clearly showed that he was a natural mechanic.

Around the dining table Ellison's family circle happened by good luck to include, in addition to Mrs. Ellison and the son whose letter appears above, and who was then in the University of Dublin, his younger brother F. O'Brien Ellison of the Ceylon Medical College, at that time home on a visit (see "A.T.M.", page 409, and "A.T.M.A.", page 477—methods of silvering in the tropics). Jokingly, family allusion was made to the elder Ellison's keen zest and enjoyment of vigorous published arguments with other telescope makers, for the files of *English Mechanics* are full of letters by him, pertaining to telescopes and telescope making, few of which evidence an inclination to take a back seat. Ellison, in reply, pointed out how sad and empty an Irishman's life would be if there were nothing left to fight about, and he added that in such a contingency something would obviously have to be hunted up. He had a strong sense of humor.

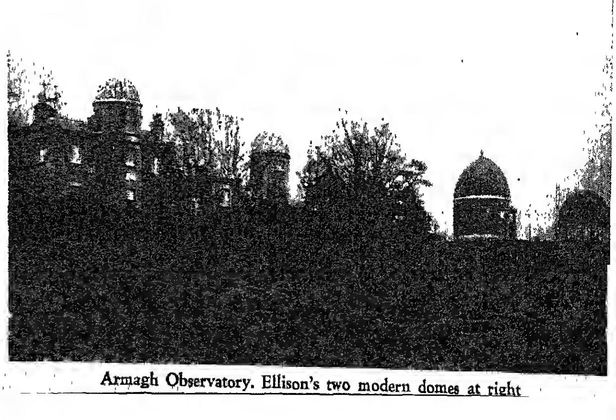
Before leaving, the writer was treated by Ellison to a splendid performance of classical music on the big organ of Armagh Cathedral, as mentioned in "A.T.M.", page 489. The installation of an electric organ and the kindness of the rector had permitted him to indulge in this happy pastime whenever the mood struck him (it is an interesting coincidence that three other coauthors of "A.T.M." and "A.T.M.A." are organists—Messrs. Hindle, Kirkham, and Haviland; perhaps organ playing smooths off the tribulations of mirror making).

Amateurs know of Ellison as a mirror maker but he was primarily a scholar, as was clearly shown by the nature of the reading matter profusely stacked about his study. He was physically a big, square man with large hands—no armchair mirror maker but a man who could do practical things and who did many of them.

The Armagh Observatory was founded in the year 1791 by Richard Robinson, Baron Rokeby, Archbishop of Armagh, and 20 acres of land were selected as the site for the buildings and for the use of the Astronomer. The power of nominating and appointing the Astronomer is reserved to the Archbishop of Armagh and Primate of all Ireland for the time being. Ellison occupied the residence, and he built for actual modern use the two domes seen at the right in the illustration. A letter from Ellison, dated January, 1926, just after the telescope-making hobby had become started in this country, makes interesting reading.

"I duly received the Scientific American for November. I have been much interested by the account of the amateur astronomers of Springfield, and should esteem it a favor if you would convey to them my congratulations on their enterprise, and truly American pioneer spirit.

"As you will see by a glance at the embossed stamp above, they have adopted the motto of this ancient observatory ["The Heavens Declare the Glory of God."—*Ed.*], which was founded in 1790, and has done great work in the 136 years of its existence. When I took over, in 1918, it had fallen on evil days, and its revenues had declined so much that it was lucky for me that I



Armagh Observatory. Ellison's two modern domes at right

could make telescopes as well as look through them. Very little of the equipment was in working order; some had to be scrapped as obsolete; roofs were far from watertight, and valuable instruments were suffering from damp. I would have been very glad of the presence of the mechanics of Springfield. But in default, I had to turn my own hands to, and a fine big job I had to tackle, with practically no funds to do it with.

"One telescope, a 6-inch refractor, I made throughout myself; to take the place of an ancient metal reflector, which had lost all its polish, and lain unused for 50 years. A fine 10-inch refractor by Sir Howard Grubb I had to take almost entirely to pieces, clean, repair, and readjust; while I brought with me an 18-inch Calver reflector, my own property. With these three instruments, the 18-inch, the 10-inch, and the 6-inch, together with the transit instrument, we are very well equipped.

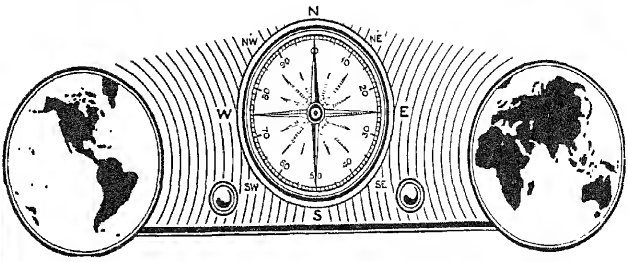
"We have a number of instruments which formerly belonged to George III, King of England, the only crowned head, so far as I know, who ever possessed a private observatory. These include a very fine clock, a mirror by Sir William Herschel, a sort of combination telescope by the famous maker Short, of 150 years ago, being a Gregorian, Cassegrainian, Newtonian, and refractor all in one; the object-glass with which King George III observed the transit of Venus in 1761; and several other articles. The combination telescope can be converted from one form to another by changing the small mirrors, and to a refractor by substituting an object-glass in their place."

In addition to his astronomical work Ellison was active in his Church. The *Church of Ireland Gazette*, kindly sent by Canon F. M. Moeran, Rector of Armagh, states that "since 1934 Canon Ellison has occupied a seat on the Chapter of St. Patrick's Cathedral, Armagh, during which time he regularly attended the Chapter and Board meetings and preached at the morning Service when it was his turn to do so. His loss will be deeply felt by this congregation as well as by the entire Church."

Possibly his congregation is aware of the extent of his prestige among amateur telescope makers the world over, but it scarcely seems likely that this can be fully sensed. Twenty thousand amateur telescope makers in America have looked to him as their chief inspiration. Amateurdom has lost heavily in losing him. His lasting monument is his long series of mirrors in many owners' hands, mainly, of course, in the British nations.

Vale and farewell.

OCCASIONALLY we are asked to publish here monthly maps of the heavens, with pertinent planet data and so on. When we dropped these, several years ago, the total number of protests was less than 100 and we decided that the space could be better used otherwise; especially since the "Observer's Handbook" of the Royal Astronomical Society of Canada, with considerably more data than we had space to present, is so easily available. Amateurs who are not familiar with this book can get it from the Society, at 198 College St., Toronto, Ont., Canada, and once it is got, the owner is more than likely to make a habit of getting it each year. It is a meaty booklet and now has simple star charts.




# WORLD-WIDE RADIO

Conducted by M. L. MUHLEMAN
Editor, *All-Wave Radio*

## S. W. Reception Hints

THE following notes are a summary of extensive data compiled mainly by experimentation and should be found both interesting and helpful, especially to beginners in the field of short-wave reception. They are contained in the "Guide to Reception of Short-Wave Broadcasting Stations," published by the U. S. Bureau of Foreign and Domestic Commerce—a booklet reviewed in this department last month:

"Broadcast transmission at 49 meters is most reliable when received from a distance of 300 miles or more, although good reception at distances greater than 1500 miles can be expected only when a large portion of the signal path lies in darkness.

"Thirty-one meter stations afford greatest reliability of service to receivers situated at a distance exceeding 800 miles. Good reception from distant stations in this band is possible both day and night.

"Reception from stations operating in the 25-meter band is most common when a span of 1000 miles or more separates the receiver and transmitter. Such transmission over distances of less than 2000 miles will be received best during daylight hours. The more distant stations, however, can still be heard well after nightfall under favorable conditions.

"In the 19-meter band, stations situated at a distance of 1500 miles or greater will be found most satisfactory. Signals in this band will generally be heard during daylight hours—rarely after nightfall or when any appreciable portion of the transmission path is in darkness. Wavelengths below 19 meters are useful only when transmitted entirely through daylight and over long distances (2000 miles or more); ordinarily they cannot be received after sunset."

## FCC May Allocate Frequency Hole

IF the request made by the Radio Manufacturers Association is granted, the Federal Communications Commission will, for the first time, allocate a frequency on which transmission will be prohibited. This has been deemed a necessity in view of the fact that the intermediate frequency employed in radio receivers for the purpose of amplification cannot be adequately protected from interference created by commercial stations operating at or near the same frequency.

A protected intermediate frequency on 455 kilocycles is regarded as the best obtainable for radio receiver manufacturers. If this protected frequency is allocated by the FCC, assurances have been given that it will be established as a standard for the industry.

Equally as odd is the group of frequencies temporarily allocated by the FCC to the General Electric Company for the specific use of diathermy machines. The purpose is not to keep the form of interference these machines create out of the short-wave bands, but rather to provide a temporary "parking space" that a study may be made of means for eliminating the interfering radiations that have in the past interrupted reception of radio signals.

## "Image" and "I-F" Interference

MANY letters are received by international broadcast station W2XAF from listeners inquiring as to why this station is received at approximately 8600 kilocycles on the dial of a modern superheterodyne receiver in addition to the fundamental assigned frequency which is 9530 kilocycles.

Such reception is known as "image response" and the source of the additional signal is the receiver itself.

In a modern superheterodyne receiver, the intermediate-frequency amplifier is usually tuned to 456 kilocycles. The tuning of this amplifier is fixed and is never altered when turning the station selector dial. The "image" of a station appears at a point on the dial which is removed from the actual frequency of the station by a value twice that of the intermediate frequency. Therefore the "image" of W2XAF which operates on a frequency of 9530 kilocycles will appear on the tuning dial at 8600 kilocycles.

This phenomenon is due to a basic shortcoming of the superheterodyne type of circuit and has nothing to do with the character of the received signal, except that the stronger the signal the greater the chance there is of being image response.

A superheterodyne receiver having no pre-selector (such sets have two-gang tuning condensers) is highly subject to image response, even from comparatively weak stations, and these images may well fall on the fundamental frequencies of other stations, thus causing interference.

A superheterodyne receiver having one stage of pre-selection (set with three-gang tuning condenser) will suffer from image response only on very strong signals. A receiver having two stages of pre-selection (four-gang condenser) is very well protected

from image response and usually will produce an image only in the event that the tuned circuits are out of alignment.

A superheterodyne receiver having no such protection may be improved by the addition of a one or two-stage pre-selector connected externally. The selectivity of the additional unit will so reduce the strength of a given signal at an off-frequency point that no image will appear.

There is no other satisfactory cure for this condition.

Intermediate-frequency or "i-f" interference is quite a different matter and is apt to show up in any receiver operated in the vicinity of commercial code stations working on approximately the same frequency as that of the fixed-tuned intermediate amplifier in the receiver. If the code signals are strong enough to "ride through" the manually tuned circuits they will be amplified by the intermediate amplifier and passed on to the loudspeaker. These signals cannot be tuned by means of the manual control and therefore are heard over a large part of if not the entire dial scale.

The cure for this difficulty is quite simple; the addition of a "trap circuit" connected in series with the antenna lead and tuned to the exact frequency of the code transmitter will prevent the impulses from entering the receiver. Once the trap is correctly tuned, no further adjustments are required.

Any competent radio service man can install and adjust such a trap in a matter of minutes.

## Ursigrams from W1XAL

GROUPS of scientists and research workers in all parts of the world will now be able to receive daily radio broadcasts of cosmic data, sun spot changes, and magnetic disturbances via short waves from W1XAL in Boston, Massachusetts. President Walter S. Lemmon (W1XAL) inaugurated the new radio service starting February 1st. At 4:55 P.M., Eastern Standard Time, each weekday, bulletins known as Ursigrams are to be broadcast over W1XAL on 11.79 megacycles (25.45 meters) and will be picked up by laboratories equipped with radio receivers not only in all parts of the North American continent but also in Europe, South Africa, and Australia as well. Weekly summaries of this data will be given each Monday at 8:30 P.M. on 6.04 megacycles (49.67 meters).

Science Service at Washington is co-operating with W1XAL in this work. They have been compiling this scientific data daily for several years. Previously these bulletins have been mailed to selected lists of research workers and also transmitted in telegraph code from NAA, the naval radio station in Arlington, Virginia, to a limited number of points. Now through the world-wide facilities of W1XAL this broadcast service will enable many thousands of scientific observers and amateur astronomers to receive up-to-the-minute information to assist them in their local observations. Through the co-operation of the Harvard Observatory, reports of any unusual celestial phenomena will also be added to the broadcast.

The name Ursigram is derived from the initials of the Union Radio Scientifique Internationale which formulated the original plan for gathering cosmic data.

## Heredia Operating Daily

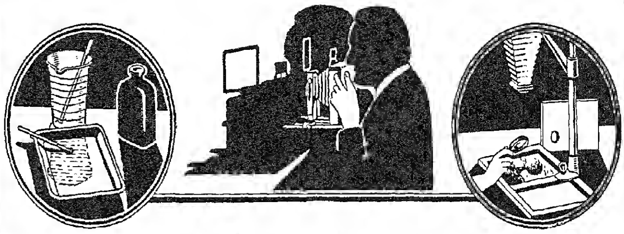
FORMERLY known as NRH, short-wave station TI4NRH, at Heredia, Costa Rica, is now operating daily from 8 to 9 P.M. and from 11:30 P.M. to midnight, Eastern Standard Time. The frequency is 9.67 megacycles.

Reports of reception should be addressed to Señor Amando Cespedes Marin, Apartado, 40, Heredia, Costa Rica, Central America.

## Ravag Back on Air

THE short-wave station of the Ravag, OER2, has been rebuilt and is now transmitting on a wavelength of 25.42 meters with a power of 1.5 kilowatts.

At the first Ursigram broadcast from W1XAL. Left to right: Prof. Harlow Shapley of Harvard Observatory, Dr. A. E. Kennelly, and Dr. Loring B. Andrews



# CAMERA ANGLES

**Conducted by JACOB DESCHIN**

## A Scoop

TIME may march on, but the inventors and the scientists who have made photography a wonderland of modern times go faster still; they fairly leap ahead. No man dare predict what new marvel they will next produce, or laugh at the wildest imaginings of his wishful-thinking camera friends. They may be dreams today, but precious realities tomorrow.

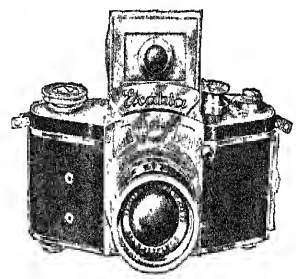
Apropos, we have this month the pleasure and the honor to present what in journalistic parlance is known as a "scoop"; that is, a beat, a tip, an advance notice or, if you will, "inside dope." In other words, a scoop—unless somebody else, willy-nilly, gets ahead of us. And this is it: a reflex camera using 35-mm film, which can be focused at either eye or waist level with provision for easy interchangeability of lenses of various speeds and focal lengths, and at a price within the reach of the serious-minded advanced worker.

This most recent advance in miniature camera design has been named the Kine-Exakta, sister of the Ihagee Exakta (made by the Ihagee Camera Works, of Dresden, Germany) which has gained such a fine reputation for itself in the vest-pocket reflex field. We owe it to the confidence of our friend, Joseph M. Bing, of the Photo Marketing Corporation, that we are able to be the first among our magazine confrères to make this announcement. At the time of this writing, the camera has not yet reached the United States, but it will doubtless be in the stores when this reaches you.

Shaped like the regular Exakta and having about the same dimensions, the Kine-Exakta is equipped with a focal plane shutter permitting speeds ranging from 12 seconds to 1/1000th of a second, as well as delayed action allowing practically the same speeds except in the slower brackets, where the longest possible automatic timing is 6 seconds. There is, of course, as with other cameras, provision for time and bulb shutter operation for much longer exposures. The automatic film transport is coupled with the shutter curtain, preventing double exposures. Being of the single lens reflex type, the Kine-Exakta cannot give parallax trouble.

The camera can be focused at eye-level as well as the usual lower level in a ground glass combined in one piece with a focusing magnifier that enlarges the visible image to 4 by 6 cm, that is, full vest-pocket size. For greater convenience and to insure critical sharpness, a secondary or auxiliary magnifier may be swung over the ground glass to give a magnified image of 6 by 9 cm, or 2¼ by 3¼ inches.

The Kine-Exakta accommodates an attractive variety of lenses in bayonet mounts ranging from the normal 5 cm (2-inch) Exakta F:3.5 and Tessar F:2.8 to a line of telephoto lenses having focal lengths of 12 to 25 cm, and speeds of F:6.3 to F:4.5. With the 5.8 cm Biotar F:2 or the 5 cm Primoplan F:1.9 the new camera becomes the Night Kine-Exakta.



The new Kine-Exakta

The camera body is beautifully embellished with the popular chromium fittings and takes the same accessories, such as filters, close-up lenses, lens shades, and so on, as the regular Exakta.

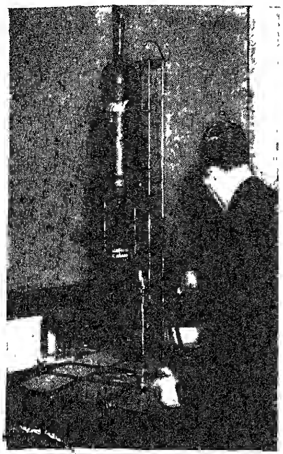
## Luster Prints

A METHOD of adding luster to prints and enlargements on matt surface papers as well as of providing a medium for spotting with a pencil that may be new to some of our readers, though old to others, is given below.

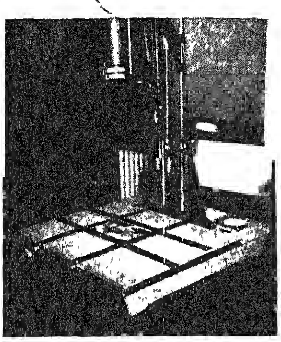
The formula calls for one part mastic varnish, one part linseed oil, and two parts turpentine, all these materials of artists' quality. After this mixture has been shaken, a wad of cotton is dipped into it and then rubbed well into the print, the surplus being removed with clean cotton. After a day or so it will be dry, without surface gloss or stickiness. Spotting with a pencil may then be done where needed, though spotting with water color will have to be done before the treatment is applied.

## Another New Enlarger

STILL another piece of news on which we have been able to obtain information in advance of the product's arrival in this country is the advent of the Komet 105, something thoroughly modern in the field of enlarging cameras. Its outstanding features are a built-in light control unit and time switch, a baseboard and easel combin having a working space of 20 by 25 inch exclusive of the portion allotted to the rhe stat and the time switch, making possib 16 by 20-inch enlargements and a bit large



Komet 105 in use



Note the large easel

directly on the baseboard-easel, and a convenient geared handle for raising and lowering the camera for determining image size. The camera is of the condenser type. Focusing is done either with the handle and rotation of the lens mount or automatically by adjusting a scale.

The camera takes films up to 6 by 9 cm ($2\frac{1}{4}$ by $3\frac{1}{4}$ inches) and smaller, and is normally supplied with a Tessar F:6.3 lens of 10.5 cm focal length, though provision is made for interchanging this in a bayonet mount with lenses of shorter focal length if and when greater magnifications are desired than those possible with the regular lens, which gives magnifications of $1\frac{1}{2}$ to 7 times linear. The diaphragm openings are made clearly visible in a lens barrel designed for the purpose, and the barrel is so designed that successively smaller stop openings may be obtained without examining the stop indicator but merely by "feeling" the stops, a little catch at each stop making this possible.

## School Photography

PHOTOGRAPHY in the schools recently had an enthusiastic boost in a successful venture at Lehigh University, Bethlehem, Pennsylvania, where a course in photography is now being given in connection with the regular journalism instruction at the school for candidates for posts on the student newspaper, *The Black and White*. So great has been the response that the class had to be divided into two sections. With the purchase of a miniature camera and the setting up of a regular darkroom, the semi-weekly news photographers were ready to go to work. The instruction, which is given by the assistant in journalism, includes mastery of developing and printing and of what it takes to make pictures under the varied conditions which newspaper photographers face.

The photographic editor of the semi-weekly may call on any member of the class to cover a photographic assignment, as a result of which pictures have been made available to him of all types of student activities, including sports, dramatics, debating, music, pledgings by honorary fraternities, dances, pep rallies, and so on.

Here's a swell idea for other schools to try.

## Weighing Scale

A BALANCE capable of weighing from 1/100 grain up to 100 grams is attracting wide attention among photographers. Compact, without loose parts, the Bennett Balance, as it is called, took eight years to perfect and is characterized by fine sensitivity, weighing to one decimal point farther than the usual low-priced counter scales. It has been recommended not only for photographic chemicals, but also for experimental work, organic synthesis, compounding, and so on. It is small and portable. There is available to it two important accessories, a black Bakelite carrying case and a dustproof table balance case made of non-inflammable transparent cellulose acetate, thus furnishing protection from dust, fumes, and injury when not in use. Certainly worth while investigating.

## Traveling With Bike and Camera

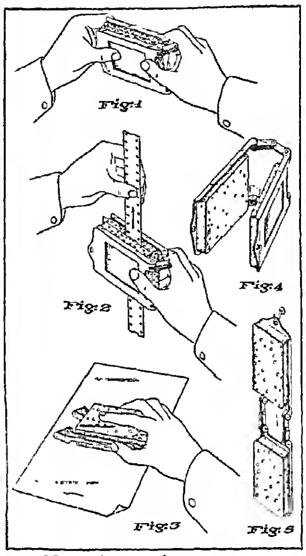
BY the time you read this, spring will be just around the corner and vacation time not very far away. Ever think of taking a cycling trip during those two weeks of release from the routine and cares of a job, and shooting pictures along the way? Lots of people are doing it and, from the news we hear, many more will be taking to this pleasant way of traveling about, whether on vacation or during week-ends. We learn that during 1936 more than 1,200,000 bicycles

A typical vacation "shot"

left the factories, held to be a record. It is estimated that this total is twice the 1935 output and nearly four times the average number made yearly between 1928 and 1934.

## Film and Paper Drying

A NEW device for swabbing negatives and prints after washing is now available. It consists of two viscose sponges mounted on a pair of toggle-hinged Bakelite shells and is known as the Duo-Service Sponge-




Using the new drying sponges

Pack. Each of the sponges when dry measures $3\frac{1}{2}$ by $2\frac{3}{4}$ by $\frac{3}{4}$ inches and the combined absorption of both sponges totals eight ounces. The double-function feature of the new device is, first, the convenience of removing surface moisture from the front and back of the film at the same time with one hand, and, secondly, the surface-drying of papers, Bromoils, and any other flat surface. The Sponge-Pack will take film up to $3\frac{1}{4}$ inches width.

The sketch shows how the two shells are compressed to remove surplus water from the sponges (Figure 1); how film is dried (Figure 2); how paper or any flat surface, such as a squeegee plate, is dried by folding the shells over, back to back, exposing two sponges ready for use (Figure 3); how the Sponge-Pack is rested on its Bakelite edge, free from contact with grit and dust (Figure 4); and how the Sponge-Pack itself is hung up to dry, the Bakelite shells against the wall, the sponges free to the air (Figure 5).

## Still Projector

THE inevitable corollary of the color transparency now so popular because of the advent of such color films as Kodachrome and Dufaycolor is the projecting camera for enlarging the picture in full color on a screen. While the projecting camera is, of course, used for projecting black and white stills as well, the manufacturers' revived interest in these machines is doubtless due to the success achieved with modern color film and the consequent demand for viewing the transparency in large size.

The latest projector to appear on the market is the Kodaslide Projector, intended for

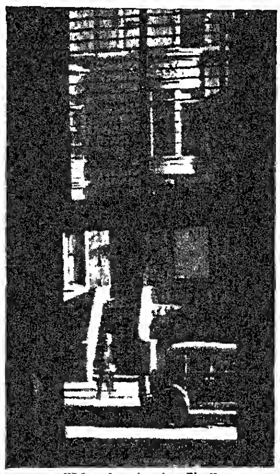
users of miniature films and for projecting individual pictures, properly masked and mounted in a 2- by 2-inch glass slide suitably bound. The lighting unit is a 200-watt 115-volt projection lamp backed by a spherical aluminum-coated glass reflector. There is a three-piece condenser lens unit and a 4⅞-inch projection lens.

## Filmpack Picture Frame

If you have ever sighed with regret at having to throw away the neatly made filmpack containers, try using them as picture frames. They are eminently efficient for this purpose and may, with a little ingenuity, be made to look quite attractive. Simply make or trim a print to fit the dimensions of the container, making provision, of course, for the borders which are to be hidden by the "frame" of the container, and slip it in. The spring on the back, which is used for keeping the film flat, will do the same service for your print.

## Through the Window

The camera bug bites hard. With most of us it does the job so well that we start shooting the minute we awake. And here's one proof. This was made with a 35-mm



"Morning in the City"

camera opened to F:4.5 and shot at 1/10th second in order to record some of the detail in the window through which the exposure was made and, deliberately, to show the man and boy in movement. Everything else in the picture is so static that it seemed the only thing to do to make the picture "human" was to show the strollers in motion.

## Filing 35-mm Negatives

If you have been finding some difficulty in filing your miniature negatives in a way to keep them away from dust, see what you think of this idea. This department has found small tins, in which Eastman 35-mm magazines come packed, to be ideal for this purpose, since they are just large enough to take a roll of 36 negatives without waste of space and the cover is deep enough to insure against the entrance of dust. The manufacturers recommend these tins for this purpose but should you not wish to buy magazines because you have some anyway and

purchase your film either in the "paper-leader" style or "load your own" by purchasing your film in bulk, your dealer can get you a supply of these tins.

## Child Photography

CHILDREN are still the world's best subjects and they're the easiest to shoot "candidly." The small boy in this picture seems totally oblivious of the camera and to be completely absorbed in watching the artist mixing pigments. Maybe we take too many pictures of children, but that's only because we love them so well we hate to miss a single chance to snap them. However, now and then we get a real corking shot such, for instance, as the contribution shown here. Notice, too, how pleasing is the composition.

"The Budding Artist"

## The Weltini

FEATURING a trigger shutter release claimed by the makers to make possible "shutter speeds of ½ second with the camera held in the hand," an automatic return to infinity and a built-in range finder coupled to the lens which also acts as a direct view finder, the 35-mm Weltini using the usual 36-exposure roll of 1 by 1½ inch film is now on the market. It has a Compur Rapid shutter with speeds up to 1/500th second and there is available a choice of three lenses, the Tessar F:2.8, the Xenon F:2, and the Xenar F:2.8, the price of the camera being governed by the choice of the lens.

## Microphotography

THOSE who are still in doubt as to just what is the difference between photomicrography and microphotography may find clarification as to the latter in a report that the United States Census Bureau is reducing by microphotography the 50,000,000 names comprising the census of 1880 and contained in 1024 volumes. By this new method a book twice the size of the largest dictionary, weighing 25 pounds, is being transferred to a roll of film four inches in diameter. The complete census record will be stored in 28 ordinary filing cabinets. [See page 266. *Ed.*]

## Small Stop for Street Pictures

FOLLOWING the suggestion of one of our readers, we hereby pass on to those unfamiliar with the procedure the method used in taking street or similar photographs where it is desired not to include passing subjects. The two essentials are a slow film and a very small diaphragm stop, necessitating, of course, a rather long exposure. The small stop, F:22 or F:32, will prevent the recording of any passing subject, although if some person should decide to stay put for a while and then pass on, he will be included in the picture, though as a "ghost." To prevent this happening, unless you want it, place the cap over the lens if any subject seems to show signs of not moving on in a hurry and uncover it again after he has passed on. You will, of course, have to make a note of the time elapsed when you put on the cap, and resume counting after removing the cap.

## Latest Simmon Enlarger

ATTRACTIVELY designed and beautifully compact is the new Omega Enlarger, the second product in this field by the makers of the now famous "suitcase" enlarger, the Simmon Complete Enlarger. Distinctly a "miniature" enlarger, it takes film sizes from 2¼ by 2¼ inches and smaller, individual film holders being supplied for different size negatives. It is equipped with a double condenser system which may be easily cleaned and may be operated from either alternating or direct electric current. The lamp-house is supported by two strong "U" channel beams of aluminum and there is ample clearance between the lens and the supporting post, a heavy tube set in a strong casting which in turn is firmly attached to the 18 by 25-inch baseboard. To facilitate composition, the lamp-house is designed to swing in an arc as well as to move vertically. The enlarger takes a 3-inch lens and is sold either with or without lens, a choice of two 3-inch lenses being available, the Simmon Enlarging Anastigmat and the Dallmeyer Enlarging Anastigmat.

## Portrait Lighting Kink

TAKING a tip from the field of sculpture photography, we made a shot of a human subject and found the result rather gratifying—at least to ourselves. A single Photoflood was suspended about three feet over the head of the subject in "Balance" to give the effect shown. Light used in this way will

"Balance"

reveal texture beautifully and dramatically. It is not, of course, suited to all subjects, but in this particular case it seemed to do the trick to perfection.

## What Is It?

WHAT do you think? It might be a snake. And then again. . . . The truth is, it is not a snake, but a harmless corkscrew set up against the background fur-

"?"

nished by an ordinary paper napkin and shot by means of photomacrography. This method of getting a large image of a section of an object and making it appear like something never seen on land or sea has been mentioned in this department before, but it is hoped that this reminder will encourage some of our readers to try their hand at this fascinating game, if they have not already done so. A wide-angle lens and a little imagination are all the requirements.

## One in a Thousand

THE lads who produce photographs for the daily press must generally have a pretty dull time of it, what with the routine run-of-the-mill stuff they must turn in to "break up" the solid text of a newspaper page or to illustrate an important story. But once in a blue moon somebody with imagination shoots a picture that clicks all around and is reproduced in a great many papers simultaneously. Such a picture was made during the recent floods by an Associated Press photographer on the job at Memphis, Tenn. It showed a group of Negro convicts, chained to each other at the ankles, carrying sandbags for the protecting wall being built against the rising waters. You have doubtless seen this picture no matter what part of the country you live in and what newspaper you read. One of the Negroes has turned toward the camera and smiles broadly, seemingly oblivious of his chains and carrying his sandbag with the air of one on a leisurely hike with his pack of supplies on his shoulder. The point of view, from below, was an inspiration and is, in fact, perhaps the making of the picture. It's a picture in a thousand and perhaps there was an element of chance in its making, but there is no doubt that the photographer had something of the sort in mind or he would not have descended to a low level in order to shoot upward against the sky.

## THE SCIENTIFIC AMERICAN DIGEST

(*Continued from page* 253)

reached land, suffering terribly from the cold and shivering violently, friends wrapped him up and gave him a pint of whisky. To his surprise this man, who was practically an abstainer and always very sensitive to alcohol, experienced almost no psychic effect from the overdose of whisky. Apparently his quivering muscles utilized the stuff very rapidly.—*Journal of the American Medical Association.*

### Filming Census Records

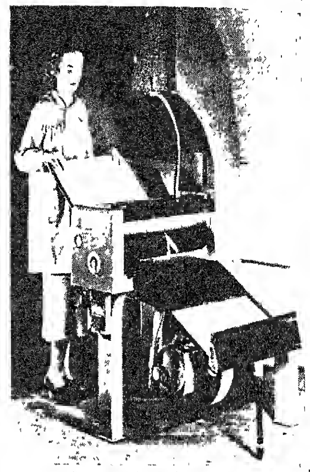
ANTICIPATING the heavy demand for proof of age in connection with social security benefits, the Bureau of the Census recently started copying in microscopic size on film the 50,000,000 names recorded in the 1024 volumes of the census of 1880, according to an announcement by Director William L. Austin. Photographic equipment especially built for the Bureau is being used.

At the same time, machines of a different type are recording on film the 76,000,000 names returned in the census of 1900, which have been transcribed on 33,000,000 cards from the original volumes.

It is these two censuses—1880 and 1900—which contain the facts that will be of greatest value to people attempting to qualify for benefits under the Social Security Act, as well as under similar legislation in force in the various states. The volumes of the intervening census—1890—were destroyed by fire and water. The volumes in the Census Bureau form the only documentary birth record of many Americans, since registration of births by local authorities was not general prior to 1915, even though New Hampshire has birth records on file dating from 1640.

Miniature copying of Census records by


Photographing census books


Photographing loose pages

photography will serve several purposes. First, the original documents of the human history of our country will be preserved from the wear and tear of frequent handling; second, the serious problem of storage will be solved, as one roll of film less than four inches in diameter will record the 70,000 names contained in a census volume twice the size of a large dictionary; third, the present method of searching for names in the 25-pound census volumes, which have to be removed from vaults for the purpose, will be eliminated; fourth, existence of duplicate records on safety film will be an added precaution against loss by fire or water.

Cameras eleven feet high are doing the major copying job. Two were designed for photographing loose sheets. A suction roller carries the pages under the lens of this apparatus as rapidly as they can be fed down a sloping tray, and the sheets are filmed "on the move." The other two cameras photograph pages in bound volumes, with a carriage moving the large books back and forth automatically to let each of the two facing pages be "shot" successively.

The specially built cameras being used are products of the experimental laboratories of the Eastman Kodak Company. No equipment to do the work was available and the machines had to be designed and individually built to meet the Bureau's needs.

It is estimated that a 95 percent saving in storage space will result from putting the census records on film. The 8,700,000 pages of census reports now in storage occupy almost a mile of shelving. Copied on film, all of the records could be stored in 28 standard-size file cases.

### Improved Magnesia Cements

BY adding 10 percent of finely divided copper powder to the cement made by mixing plastic magnesia with a solution of magnesium chloride, many of the disadvantages of older magnesium oxychloride cements are overcome. Magnesium oxychloride cements have been used for building purposes because of their relatively high strength as compared with Portland cement concretes. They have also been used as adhesives and binders in composition floors, stucco, tiles, and other building materials,

Their principal drawback has been that they dissolve and disintegrate when exposed to the weather or when repeatedly washed They also show a large change of volume on curing.

The addition of copper powder to the mix overcomes these disadvantages and actually increases the strength and resiliency of the cement while materially increasing its resistance to water. The new cements adhere permanently to stone, brick, concrete, marble, wood, and fibrous materials. Adhesion is generally greater than the strength of the materials themselves. They even adhere tightly to glass. Because of their high strength they are recommended for preformed articles such as tiles, garden furniture and statuary.—*D. H. K.*

## Rayon Typewriter Ribbons

TYPEWRITER ribbons made of specially processed fine denier, multi-filament, Bemberg yarns were announced recently by Remington Rand, Inc. It is pointed out by W. H. Mathews, General Manager of the typewriter division, that this is the first time synthetic yarns have been used commercially for this purpose, and opens up an important and heretofore unexploited market. Ribbons used previously for typewriters have been made either of silk or cotton yarns, and for the most part these have been imported materials.

The extreme fineness of the ribbon is exemplified by a filament count of 11,520 filaments per square inch, stated to be an accomplishment never before attained in typewriter ribbons. The ribbon makes possible clear, sharp letters having the appearance of printed type. Uniformly longer ink life than any ribbons on the market, and exceptional durability are important qualities of the new ribbons made possible by the unique properties of this specially processed cuprammonium yarn, it is stated.

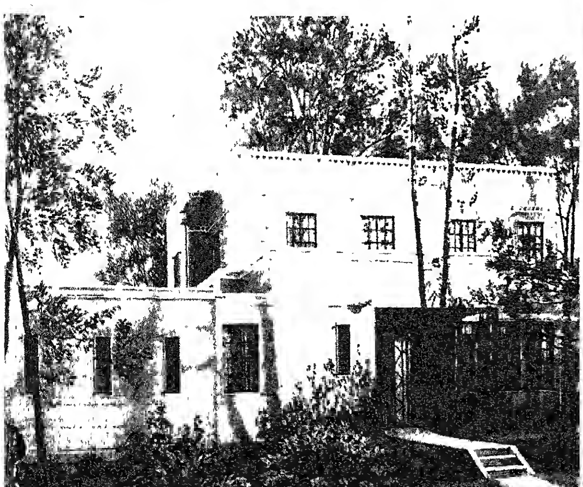
## Porcelain Enameled House

EMPLOYING the newest in both style of architecture and building materials, a recently completed St. Paul, Minnesota, house has attracted the attention of building stylists all over the country. It strikes an entirely new note in residential construction.

Gleaming white porcelain enameled steel sheets cover the entire exterior of the residence. Rains or a garden hose will keep it just as white as the day it was built; it will never require a coat of paint.

In keeping with the modern tone of the exterior, this well insulated home is equipped with the latest type of air conditioning and heating plant.

The building was constructed by The Insulated Steel Construction Company, while all metal used in the structure was manufactured by The American Rolling Mill Company.



**ICE HEAT**

**FRESH flowers shipped from the West Coast are "heated with ice." Ordinary wrapping and insulation previously would not prevent temperatures far below freezing from destroying the flowers entirely. A coating of ice holds them to a much warmer temperature—approximately the freezing point.**

## Trichinosis Greater Problem in United States than Anywhere Else

THE United States has the greatest trichinosis problem of any country in the world, Dr. Maurice C. Hall of the National Institute of Health, U. S. Public Health Service, recently declared. Millions of persons are involved in the problem of this disease that results from eating mealy pork, studies by Dr. Hall and his associate, Dr. Benjamin J. Collins, showed.

Trichinosis is a painful disease that may end fatally. It is caused by worms, called trichinae, which are frequently found in pork. Thorough cooking of the pork kills the worms and protects against the danger of eating the infested meat. Unfortunately, however, pork is not always cooked thoroughly enough to kill the worms, and there

is a growing tendency to eat raw pork. The popular raw hamburger, for example, often contains some pork as well as beef.

One out of every eight Americans, or, 16,250,000 over the age of infancy, have some of the trichina worms in their bodies. Drs. Hall and Collins estimate from their post mortem examinations of hundreds of persons who died in Washington, D. C., hospitals, but who came from every state in the Union and every walk of life. Not all of the millions infested have enough worms to be sick with trichinosis. Probably 769,250 living Americans, however, have had trichinosis, the scientists estimate, and there are probably thousands of deaths from the disease every year.

Boston and San Francisco are the two largest trichinosis centers, and the South is freest from the disease. The reason for this, and for the general high incidence of trichinosis throughout the country, is a matter of how swine are fed. In the North, swine are largely fed on pork scraps, garbage, and swill. In the South, the old custom of letting swine roam at large and forage for their own food, bringing them in for final fattening on peanuts, cuts down the number of worms they get in their feed to a very great extent. There is a very large garbage-fed hog industry on the West Coast, including what is probably the largest plant of this sort in the world. This supplies pork to San Francisco and Los Angeles and probably accounts for the high trichina infestation among persons living there. Control of trichinosis depends on better and more extensive meat inspection and on improving the methods of feeding swine.

Housewives and cooks are another class especially exposed to the danger of trichinosis from infested pork which they often sample in its raw state while preparing it.—*Science Service.*

## Freak Accidents

T. A. BURKE, editor of *Public Safety* magazine, vouches for the following freak accidents of recent months:

The acetylene torch operators (two cases) who cut holes around themselves in the top of giant steel tanks and fell through . . . the power drill operator who did the same thing through concrete and landed on the floor below . . . the manhole cover that blew up in Chicago just as a motor car was passing over it . . . the explosion that failed to occur when a California driver of a truck of dynamite (plus the detonator caps) drove over an embankment to avoid hitting a bus load of children . . . the Chicagoan who unknowingly hit a woman pedestrian and carried her three blocks on the bumper, and then was charged with leaving the scene of an accident . . . the eight-year-old Columbia, Missouri, girl who slipped between the ties of a railroad bridge and hung by her head . . . the man who died of heart failure at the wheel of his car in New York and then drove on to kill one person, injure three, and wreck three store fronts.—*Science Service.*

### TREES

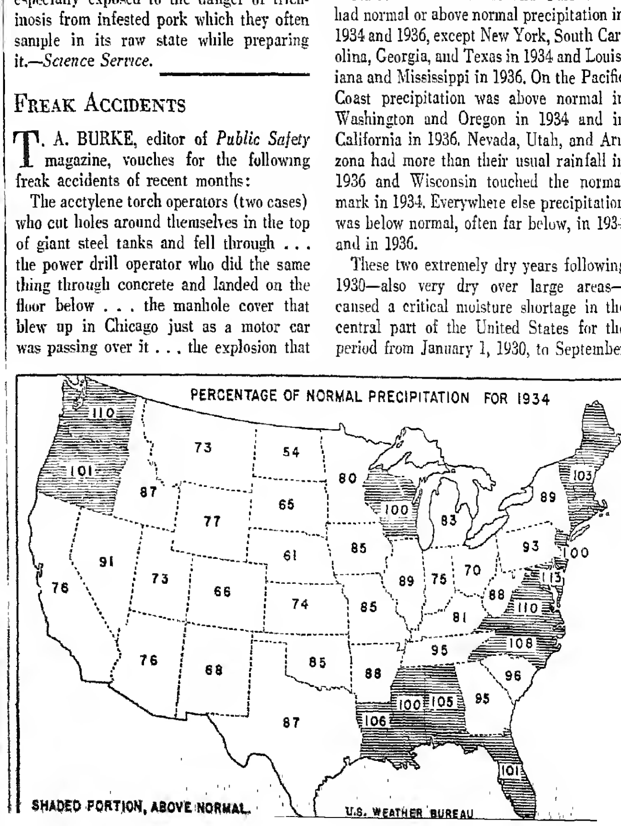
DURING the year 1937 the Soil Conservation Service plans to plant approximately 175 million trees and shrubs as part of the erosion control program.

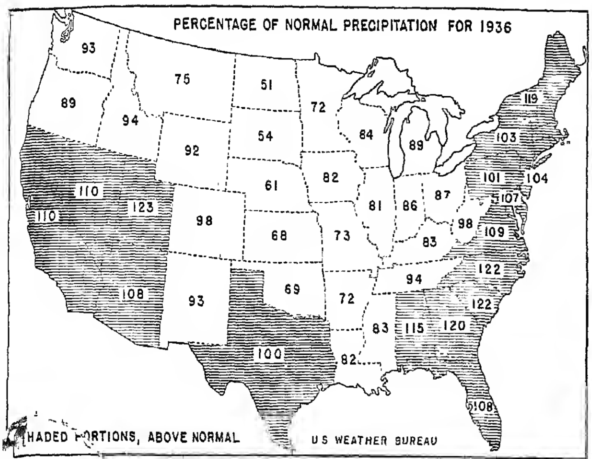
## Weather Owes United States Moisture

THE weather owes most of the United States a great deal of moisture, according to J. B. Kincer of the United States Weather Bureau. The year 1936 left a deficit in rain and snowfall somewhat greater than that left by 1934 and in about the same areas—practically all of the interior of the country. Precipitation maps for the two years show rainfall reaching normal only in coast states, and not in all of them both years.

States on the Atlantic and Gulf Coasts had normal or above normal precipitation in 1934 and 1936, except New York, South Carolina, Georgia, and Texas in 1934 and Louisiana and Mississippi in 1936. On the Pacific Coast precipitation was above normal in Washington and Oregon in 1934 and in California in 1936. Nevada, Utah, and Arizona had more than their usual rainfall in 1936 and Wisconsin touched the normal mark in 1934. Everywhere else precipitation was below normal, often far below, in 1934 and in 1936.

These two extremely dry years following 1930—also very dry over large areas—caused a critical moisture shortage in the central part of the United States for the period from January 1, 1930, to September






30, 1936, despite the plentiful rains and snows during short periods, especially in 1935.

The year 1937 seemingly wished to make amends, at least in the Ohio River Valley, with the resulting enormous floods from which the valley will not fully recover for a long time.

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**APPLES**

*DESPITE the fact that orange production is up 155 percent since 1915 and grapefruit production 118 percent since 1921, there has been no increase in consumption of apples in this country in the last few years. Since the population has increased, per capita consumption of apples has obviously decreased.*

## Make Drinking Water Safe

PERSONS living in or traveling to areas where the water supply may be polluted temporarily can assure themselves of a safe drink of water by adding a drop of iodine to each glass of water. The ordinary tincture of iodine for first-aid treatment of cuts does the trick of destroying typhoid fever or other harmful germs. A drop will make as much as a quart of water safe for drinking. Persons traveling can carry with them the little ampules made for first aid use. The value of iodine for this purpose was discovered by Maj. A. P. Hitchens of the United States Army Medical School. —*Science Service.*

## Dyes Kept From "Bleeding"

YOU might shudder at the odor of a stale egg; or turn up your nose at the smell of a bad fish; or choke on ammonia fumes. But the ammonia which chokes, the hydrogen sulfide gas which makes the egg smell bad, and the phosphine gas which makes the fish smell foul, says *Science Service*, are the basis of the newest test tube "babies" for the textile industry—the "onium" compounds.

Watch particularly the quaternary ammonium chemical infants. These are complex compounds with hearts of nitrogen, phosphorus, and sulfur atoms. They bring joy to the textile dyer, printer, and finisher, who is responsible for the beautiful color and finish of the clothes you wear.

Does the dye in a dress "bleed"; that is, run when it is wet or contacts perspiration? Just dip it in a warm solution of cetyl pyridinium bromide, rinse, and dry. Notice how fast the dyes become. Water and perspiration no longer make them run.

Did the dyer put the wrong dye on the fabric, or didn't the dye go on evenly? He needn't worry. He can strip the dye completely from the fabric and dye all over again. Trimethyl cetyl ammonium bromide, another one of those new "onium" compounds, does the trick.

Other of the "onium" chemicals whose names need not worry the layman have now made it possible for the dyer to use wool dyes on cotton and synthetic silks. This is helpful for the wool dyes have always been of brighter shades than the others.

Finally, the new compounds have been found to serve, also, as the nuclei out of which new dyes for wool and acetate rayon can be synthesized. Many patents have been taken out here and in Great Britain for the new uses of these onium compounds.

## Electrical Appliances May Cool Off With Age

WHY does that toaster or percolator or waffle iron take so long to do its job? It used to be so fast when new. That frequently posed question can be answered by referring to the "growth" of the heating-element wire which, in turn, increases resistance and thereby cuts down wattage and subsequent heat.

"Growth of alloy wires for heating elements," points out Wilbur B. Driver, "results in permanent increase in length during long heating at high temperatures. It takes place even though the heating element is under no tension or mechanical load. And it occurs in all resistance wires, but more with some alloys than with others. The effect of sag on resistance wire is similar to growth, although here the cause is different. We have the actual weight of the wire which, when heated, is deprived of its tensile strength and therefore droops. A resistance wire should obviously have suffi-

weight at operating temperatures. Sagging, as with growth, also causes an increase in length during service and thereby decreases wattage and operating temperature.

"Inexpensive resistance wires used in cheaper grade electric appliances are characterized by such a high rate of growth that they must be discarded before actual burnout. The operating temperature drops so low—as much as 200 degrees, Fahrenheit, in many instances—that such elements must be discarded.

"Nickel-chromium alloy wires used in better grade appliances, will show a useful life almost as long as the life to burnout. Growth and sag are minimized. It therefore pays to insist on a good grade nickel-chrome wire in heating elements that must remain 'hot' throughout a long service life," concludes Mr. Driver.

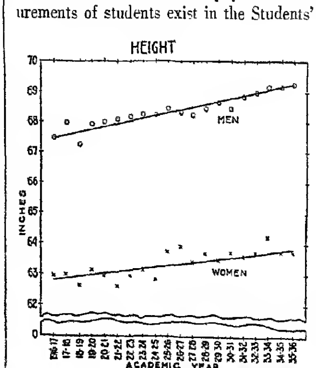
## We Grow Taller, Larger

SCIENCE undoubtedly has had more than a little to do with the fact, brought into the clear by many modern observers, that the race is taller today than it used to be. In the *Journal of the American Medical Association*, Laurence B. Chenoweth, M.D., shows new evidence of the same kind.

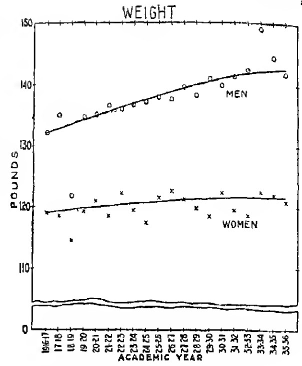
"In 1921," he says, "Clelia Mosher noted that the height of Stanford University women students had increased one inch in 30 years. In 1926, Czechoslovakian children were found to be one year advanced in size over what they were 30 years before. In 1927, Gray found American boys of American born parents to be more than two inches taller than the same type were reported to be 50 years earlier."

He continues: "An interesting study was made at Harvard College several years ago when the records of 1166 fathers of Harvard students were searched out and compared with the present-day records of their 1461 sons. The fathers were measured between the years 1875 and 1910 and were found to have a mean height of 68.6 inches. Their sons averaged 70 inches tall. Similar studies were also made at Wellesley, Vassar, Smith, and Mount Holyoke, and the college daughters averaged 64.8 inches in height, which was 1.1 inches taller than their mothers had been while students. The whole study was conducted by Bowles and published as a monograph. This investigator concluded that stature has been increasing at Harvard for the past 80 years or more and that the mean annual increase has been at the rate of one inch every 32 years.

"Good records of careful physical measurements of students exist in the Students'




We are growing taller




We are growing heavier

Health Service of the University of Cincinnati," he finds. "These records go back to 1916 and contain a history and physical examination for each student. Among other things they show his place of birth, his present legal residence and the place of birth of each of his parents."

Dr. Chenoweth summarizes his findings in the two graphs which are reproduced, and he concludes that:

"The probable causes of the increase in stature and weight of young people are better nutrition in infancy and childhood, less communicable disease, higher standards of living, and a higher degree of health intelligence among people in general."

**RIDDLE**

**WHAT is it that can look two ways at once, swims in the water, has a tail like a monkey, the shell of a beetle, and the head of a horse? The answer is: the hippocampus, or "seahorse." One other peculiarity is that the hippocampus reverses the ordinary way of nature, for the male, instead of the female, gives birth to the offspring.**

## Sunspots May Be Related to Human Events

EVER since they were discovered, sunspots have been associated with various cyclic terrestrial phenomena, and the maxima have sometimes been stressed as heralds of disaster. Precipitation, rainfall, crop failures, famines, panics, wars, and pestilences have been associated with sunspots. Some of the relationships claimed have been supported by considerable evidence, but most of them cannot be considered as proved.

An outstanding objection is that the sunspots themselves are not primarily causative. They themselves are probably results of deeper forces which, it is quite likely, produce profound effects on the surface of the earth and consequently in human history. Except for two or three exceptions, the relationships between sunspots and terrestrial phenomena are secondary.

The intervals between sunspot maxima have varied from seven to 15 years. The *average*, however, has been approximately 11 years. The intervals between maxima and minima vary between four and seven

years. This appears not to be entirely arbitrary, for a general rule has been found that the more intense the sunspot maximum, the shorter the time required for it to develop from the preceding minimum and the longer it takes to recede to a minimum once more.

Thus, it will be seen, astronomers cannot actually predict the years of sunspot maxima and minima. They can say with considerable assurance, however, that there will be one or both in an 11-year interval.

It is probably of considerable significance, however, that the time from minimum to maximum is considerably less than that from maximum to minimum. The average for increasing spottedness is 4.62 years; for decreasing, 6.51 years.

It might be quite possible to show that there have been major wars during each of the 50 years of sunspot maxima in the past centuries, or that such wars shortly preceded or followed such maxima. It must be remembered, however, that few years have passed without a major war somewhere on earth. The same can be said for panics, famines, and other happenings. If there is any relationship, it is far too elusive to be discovered at present.

### FLAVOR

CANNED grapefruit juice will recover much of its original flavor if, upon opening, it is poured from vessel to vessel several times so that it is aerated.

## USE WATER TO INFLATE TIRES!

PNEUMATIC tires are now being partially filled with water to improve traction! We refer, not to the tires you use on your automobile, of course, or to those on your truck, if you own one, but to farm tractor tires, those huge rubber casings which roll over the fields, pulling plow or harrow, doing the work horses once did.

After several years of experiment with tires on farm tractors and other farm implements, one of the greatest problems found was to keep tires from bouncing around, and thus losing their traction, while they were pulling heavy equipment over rough, uneven ground.

Metal weights were in many cases attached to the wheels to weight them down, but these were an additional expense to the tractor operator. Putting them on and taking them off was a constant inconvenience.

So engineers of The B. F. Goodrich Company, after numerous experiments, now recommend the use of water in farm tractor tires. Use of water provides normal cushioning without rebound or bouncing of the tractors or other equipment. They give the tractor greater tractive ability and better riding qualities.

To facilitate putting the water into the tires, the engineers have developed a simple, inexpensive "adapter," one end of which is fitted to a garden hose and the other to the tire valve.

Ordinary city water pressures of from 30 to 60 pounds are usually adequate to fill the tires. Filling may also be accomplished from a tub or barrel by gravity flow, or by means of an inexpensive pressure tank where no water pressures are available.

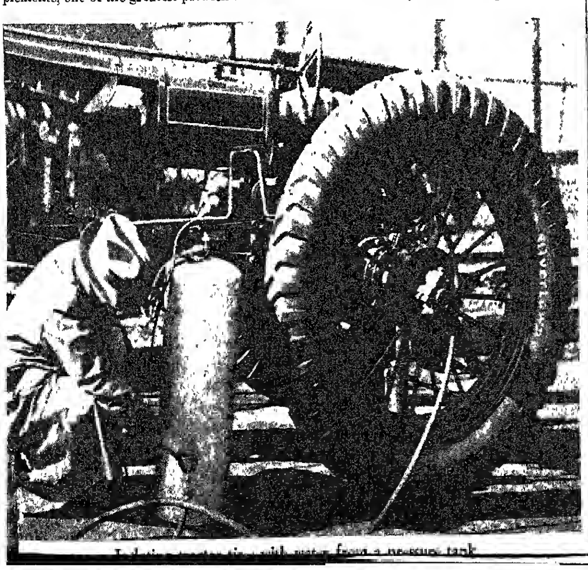
Many farm tractors equipped with rubber tires are operated in freezing weather, and for these are recommended solutions of commercial calcium chloride, ordinarily used for dust-laying on roads.

The tire should be filled with liquid until the level reaches the inflation valve. After that amount has been put into the tire, inflation with air should be effected, just as in ordinary practice. The air pressures in tires in which water is used are the same as the regular pressure.

The amount of water put into the tire ranges from 13.80 gallons to 53.30 gallons according to size. Water used takes up from 74 percent to 78.47 percent of the inner space, depending on the tire.

## NEW CELLULOSE ETHERS

NEW compounds made by the reaction of cellulose, treated with caustic soda, with ethylene oxide are reported as having considerable advantages over regenerated cellulose made by the viscose process. The



Inflating tractor tires with water from a pressure tank

new compounds are known as hydroxyalkyl ethers and can be formed directly into films or filaments, or by treatment with acids can be converted into a variety of other useful compounds. These ethers can be formed in a variety of ways and when made into films have a higher strength than the customary viscose films, familiar as cellophane, and are less affected by moisture.—*D. H K.*

## Kathamobile

SOMEBODY is always getting together a lot of odds and ends and making something out of them; this time it was a group of advertising men who wanted a publicity idea for a cigarette company. They gathered some fiber wallboard, some light lumber, four wheels from a hand express truck, a storage battery and a few other things that were not so easy to identify, and got the result seen in the accompanying photograph.

"As anyone can see," they said, "it's *not* an automobile. We didn't know what to call it, so we named it the kathamobile, because it's run by an ordinary Kathanode automobile battery. Because we knew the battery would feel at home pushing a starter motor, we picked up a second-hand one and used it as our power plant."

The accomplishments of this tiny machine are really remarkable, and show the stamina built into the ordinary auto battery with which everyone is so familiar. With the battery, the kathamobile weighs about 185 pounds. It will carry a person of ordinary weight, say about 150 pounds, at a speed of 15 miles per hour, though the advertising model shown is geared to run at a little over half that speed.

The kathamobile will run at its full speed for between seven and eight hours without recharging the battery or checking the electrolyte. To prevent too heavy a load being thrown on the battery at once when starting, the power is transmitted through two V-belts, running from the old starter motor to the gear reducer, and from the reducer to the axle. These slip enough to permit the car to get started before too much of a pull is exerted.

This first model had to look like a high-priced professional job, and therefore cost slightly in excess of what it might have been made for. The gear speed reducer cost, second hand, about $3.50, the old but sturdy starter motor was picked up for less than five dollars, and the battery cost 19 dollars. Wallboard, wheels, bearings, lumber for the chassis, axles, belting and all the miscellaneous articles that were used, plus the assistance of a carpenter and an electrician brought the total cost up to little more than 75 dollars.

Believing that Scientific American readers might be interested in building their own kathamobiles, for their children or for themselves, the men who built the original model have offered us plans and specifications for free distribution to anybody who wishes to write in for them. If you are handy with tools, it should be easy, and a lot of fun, too.

## Metaphosphate Fertilizers

CALCIUM metaphosphate made by t[illegible]ing phosphate rock with the ho[illegible]e-action products of burning phosphorus contains the equivalent of 65 percent phosphoric acid and is suggested as a more satisfactory compound for introducing this necessary constituent into fertilizer. Formerly calcium acid orthophosphate made by treating phosphate rock with sulfuric acid was the compound universally used for th[illegible] purpose. However, this product normally contains the equivalent of only 15 to 17 percent of available phosphoric acid.

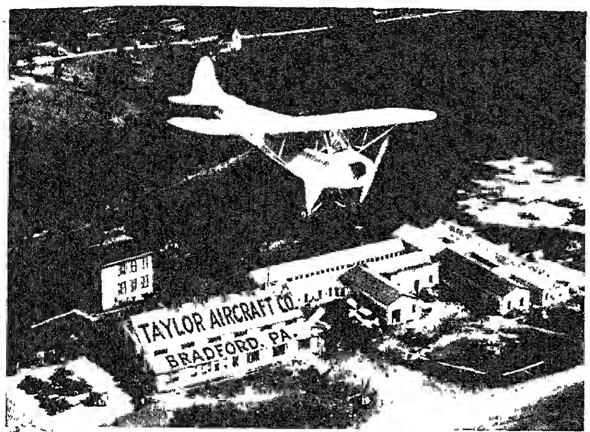
Interest in the new calcium metaphosphate for fertilizer use was initiated by the fact that the Tennessee Valley Authority could easily make it by the use of the electrical power available from its developments.—*D. H. K.*

## Welding Foundation

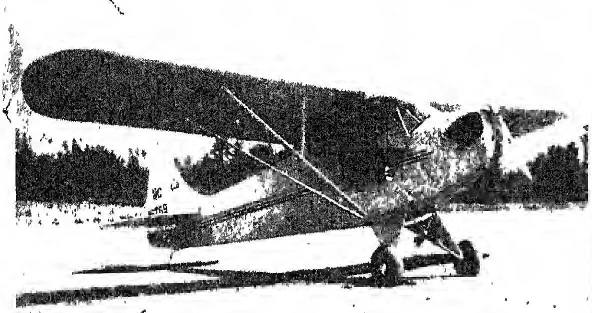
ONE of the richest awards ever established for competition in the field of mechanical science has just been announced by The James F. Lincoln Arc Welding Foundation, Cleveland, Ohio.

To stimulate intensive study of arc welding, 200,000 dollars will be distributed by the Foundation among winners of 446 separate prizes for papers dealing with this subject as a primary process of manufacture, fabrication, or construction in eleven major divisions of industry.

The principal prize winner will receive not less than 13,700 dollars. Other prizes range from 7500 dollars to 100 dollars—the




The Taylor "Cub," an excellent low-priced plane, aloft and on the ground



latter sum to be awarded to each of 178 contestants who receive no other prize, but whose papers are adjudged worthy of honorable mention.

Formed at the close of 1936 "to encourage and stimulate scientific interest in, and scientific study, research and education in respect of, the development of the arc welding industry through advance in the knowledge of design and practical application of the arc welding process," the Foundation already has won wide acclaim among educators and other leaders in the engineering world.

Prospective entrants among engineers, technicians, designers, and skilled workers familiar with the uses of arc welding are urged to communicate promptly with Foundation Secretary A. F. Davis, P. O. Box 5728, Cleveland, for complete details of the rules and conditions governing the competition awards.

## From 1270 Dollars Up

At the National Aviation Show one manufacturer of a popular or "flivver" plane announced a reduction of 200 dollars in price just before the opening, and advertised his machines from 1270 dollars up! The announcements sometime ago of the 700 dollar flivver airplane by the Air Commerce Bureau only served to disturb the light airplane market, and to misguide the public. Now, a group of independent manufacturers, entirely without governmental aid in any shape or form, are bringing the "flivver" plane closer and closer. Porterfield, Taylor Aircraft, Rearwin, and Aeronautical Corporation of America are doing great things and selling large numbers of their small planes, ranging in price from 1270 to some 1500 dollars, providing excellent flying qualities, cruising range of some 200 or more miles, top speeds of around 90 miles an hour, excellent equipment and real cabin comfort, low landing speeds, and cheap maintenance. It is well known that one of these companies recently placed an order for a million dollars worth of 40-horsepower Continental Aircraft engines of the four-cylinder opposed type, and that the same firm sold its thousandth small airplane just before the show. No wonder that the number of flying clubs is growing rapidly and that young private owners are increasing in number. Our photographs show an excellent example of these light planes, in flight and on the ground.—*A. K.*

### STENTORIAN

**When you make a long-distance telephone call, say, for example, over a distance of 700 miles, approximately 3000 loading coils are used to amplify your voice. Each amplifier multiplies the volume of your voice tenfold. This amplification is roughly equivalent to the magnification of a single atom of hydrogen to fill the entire solar system.**

## The Institute of Aeronautical Sciences

At the recent annual meeting of this Institute, members were called upon to listen to the presentation of 54 technical papers (some of them deeply mathematical) in the short space of three days. No wonder

that they suffered some degree of mental indigestion. But it was worth a little agony to learn of progress in so many phases of aeronautics, some of which are briefly touched upon in the following paragraphs.

The Instruments and Meteorology Session was largely devoted to the question of upper-air soundings with the aid of the radio meteorograph. In spite of its formidable name, the radio meteorograph is nothing but a relatively small free balloon equipped with automatically recording instruments and means for transmission of their records to ground observers.

A concentrated attack on the problems of the upper atmosphere is being made by the Weather Bureau, the Harvard Blue Hill Observatory, and other scientific centers. The investigators expect not only better weather service as a result of this research but also definite guidance as to the "optimum" flight path to be taken by a pilot for maximum economy of operation and smoothness and comfort in flying.

But Professor Piccard of stratosphere balloon fame proposes to go one better than the radio meteorograph by going up in person to the greatest altitudes. Professor Piccard, now working at the University of Minnesota, proposes to meet the difficulties of stratosphere exploration by using a "dog team" of large numbers of small balloons, suitably tied together. Preliminary experiments with a few balloons have apparently established the usefulness of the "dog team." The first ascent will be made in an open basket, with a dog team of 80 balloons giving a total lift of 400 pounds. In this trip the scientist will rise to an altitude of about 10,000 feet. If all goes well the next ascent will be made with several thousands of these small balloons, and an ascent in a closed basket, supplied with oxygen will be made to an altitude of perhaps 20 miles—much higher than all previous records.

For landing with such a "team" it is obviously impossible to use the conventional balloon rip cord. Instead, Professor Piccard plans to blast off the strings of many of the small balloons with dynamite caps which will be electrically controlled from the basket. These dynamite caps are of the type used in mines, will not explode hydrogen gas and are thus perfectly safe. Such a personal study is of course more satisfactory than even the best work of the radio meteorograph.

The Institute ranged from recondite theories of the turbulent flow of air to such practical and highly important topics as improvement in engine maintenance. During the World War and for some time thereafter, an operator employing the famous Liberty engine was considered fortunate if it gave him service for a hundred hours before needing a complete overhaul. Today, improvements in engine design and better understanding of the problem of engine maintenance have changed the situation entirely. At the present time oil is changed after 120 hours of flying, and a complete overhaul is made after every 600 hours. Cost of replacements in early overhaul practice was 300 dollars and this was at the end of 100 hours. Today the replacements total 75 dollars at the end of 600 hours. No wonder that flying is becoming both more practical and more economical.

It is a "deep secret"—known to everyone in the industry—that a number of airplane manufacturers are experimenting with planes for stratosphere flight, to be equipped with supercharged passenger cabins. Since the meeting these attempts are as "secret" as ever, except that we know something definite of the development work of one of these organizations, the Glenn L. Martin Aircraft Company. J. S. McDonnell, an engineer of this corporation, presented some interesting facts regarding his experiments with a circular fuselage and a supercharged cabin.

The consensus among the assembled engineers seemed to be that the pressure or supercharged cabin had certain definite advantages beyond the ability to fly at high speed in the thin air of the stratosphere. Among these advantages is the fact that passengers in such "pressure" cabins will be protected from all the unpleasant effects of drastic changes in altitude. Equipped with a supercharged cabin, an air[illegible] could be brought down rapidly from [illegible] altitudes, if considerations of either safety or economical operation required descent at a rate which would be torturing to the ear drums and sinuses of all on board a conventional aircraft.

In the course of his experiments Mr. McDonnell placed his "stratosphere," circularly built fuselage in the altitude chamber of the Bureau of Standards, wherein the pressure may be rapidly brought down by pumping out the air. A sudden drop in pressure equivalent to 10,000 feet in 1.4 minutes caused the occupants no discomfort. Even a fictitious climb to 25,000 feet in 14.3 minutes was perfectly harmless, although it produced some eructation ("belching," in vulgar parlance) by the "passengers." It was found that the administration of oxygen through a tube held in the mouth was far less pleasant than the introduction of oxygen into the cabin as a whole.

The circular fuselage, built of high strength aluminum alloy, was found capable of withstanding higher pressure inside than out. Owing to rebreathing possible in such a cabin, and the warmth introduced by the passenger's own animal heat, comparatively little artificial heating will be needed (only one quarter of a kilowatt per passenger) so that electrical heating at the greatest altitude will be possible. Mr. McDonnell thought that only 10 percent of the pay load of an airliner would have to be sacrificed to make the cabin air-tight, to provide supercharger equipment, and so on.

The papers presented at the Institute meeting by our leading aeronautical engineers and scientists will take months for full publication, so perhaps we can give the gist of some of them in a few moments. Stainless steel, properly used, will give a structural weight no greater than that of aluminum alloy, and since stainless steel can be electrically welded, the cost and worry of thousands of rivets will be eliminated. The driving of automobiles can be investigated scientifically at the proving grounds; why should not airplanes and their maneuvers be also investigated by the use of scientific instruments, instead of reliance being placed on just what the pilot says? Gusts in land flying are equivalent to a vertical up-current of 30 feet a second, over the ocean to vertical currents of 25 feet a second, so that over-ocean flying will n[illegible] really be much smoother than over-la[illegible] flying.

Altogether, the Institute meeting was of great interest and importance.—*A. K.*

# CURRENT BULLETIN BRIEFS

*(Bulletins listed as being obtainable through Scientific American can be supplied only by mail)*

NIGHT PHOTOGRAPHY, by Dr. Walther Heering, is a compact paper-bound book of 54 pages that gets right down to the solid meat of its subject and tells about materials, exposures, and results to be expected in all types of photography after dark. It contains 43 illustrations of night photographs, some of which are really remarkable. It may be obtained through your photographic dealer or direct from *Burleigh Brooks, 127 West 42nd Street, New York, N. Y.—One dollar.*

AMERICAN TENTATIVE STANDARDS FOR ACOUSTICAL TERMINOLOGY is of particular value to sound engineers in that it will eliminate confusion in motion picture, radio, and building fields by setting a basis that eliminates the possibility of misunderstanding. *American Standards Association, 29 West 39th Street, New York City.—1 to 9 copies, 25 cents each; quantity prices on application.*

PRACTICAL AND THEORETICAL PHOTOGRAPHY, by Julian M. Blair, contains 107 mimeographed pages complete with pertinent drawings covering all phases of photography, particularly from the angle of the darkroom worker who really wants to know what it is all about and how to do it. It also includes an appendix of formulas and weights and measures. *Dr. Julian M Blair, University of Colorado, Boulder, Colorado. —One dollar.*

RECEIVING TUBE MANUAL tells briefly of the operation of vacuum tubes in general and of the function of the various elements in the tube. It then describes radio tube applications and how the tubes function in different circuits. Following these sections are complete descriptions of all of the tubes on the market, their characteristics, uses and installation. 192 pages of solid meat including numerous diagrams, characteristic curves, and drawings of tubes. Technical Series RC-13. *RCA Manufacturing Company, Inc., RCA-Radiotron Division, Harrison, New Jersey.—25 cents.*

A NEW WAY TO GET MORE POWER FROM YOUR CAR is a little 16-page pamphlet that takes into consideration what is usually thought of as the least important liquid in the operation of a motor car—water. It deals specifically with the corrosion that is present in any automobile cooling system and tells what to do to prevent it. *Write for Bulletin 437A, Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

PROBLEMS IN HUMAN HEREDITY, by Prof. V. W. Jackson, is a compact book of problems on the basis of learning by thinking and doing. Something new, supplementing a general course in biology or genetics. Many original illustrations. *V. W. Jackson, University of Manitoba, Winnipeg, Canada. —50 cents.*

[DIR]ECTORY OF ASSOCIATION MEMBERS lists members of the Association of Consulting Chemists and Chemical Engineers, Inc., and contains valuable details about the [work which leading consultants in various] branches of chemistry are specially prepared to undertake. Any business man or industrialist who on occasion requires chemical research assistance will find this Directory to be a valuable shortcut to getting the right man for the job. *Association of Consulting Chemists and Chemical Engineers, Inc., 50 E. 41st Street, New York City.—Gratis.*

THE SCHOOL SHOP, lavishly illustrated with photographs and diagrams, gives specific suggestions for laying out machine shops in Junior and Senior High Schools, as well as in Vocational and Trade Schools. An interesting historical sketch—"The Story of the Lathe"—is included. Prices are given on most of the equipment. *Write for Bulletin 437B, Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

THINGS I'VE BEEN THINKING ABOUT, by Henry Ford, is a reprint, in bound book form, of an article which appeared originally in the *American Magazine*. It is essentially a commentary on industrial progress, wealth, and the machine. *Fleming H. Revell Company, 158 Fifth Avenue, New York City.—60 cents.*

LOW-LOSS PARTS BULLETIN lists radio parts for use in critical circuits and assemblies. It includes standard and special forms for coils and high-frequency transformers, mica insulated parts, aluminum shields, and so on. *Write for Bulletin 437C, Scientific American, 24 West 40th Street, New York City. —3-cent stamp.*

OVERSEAS TELEPHONE SERVICE is a pocket-size booklet that tells briefly, yet clearly, the story of telephone service to all parts of the world, including the radio links, scrambling of speech to secure privacy, effects of storms on traffic, and other details pertinent to the subject. *American Telephone and Telegraph Company, Long Lines Department, 32 Sixth Avenue, New York City.—Gratis.*

BETTER TENANT FARMING, by Cornelius J. Claassen, is a 50-page booklet on farm management that is primarily of interest to the absentee owners of tenant farms. It strongly advocates proper management of a farm on a business basis rather than on the haphazard basis that so often prevails. *Farmers National Company, 388 Brandeis Theatre Building, Omaha, Nebraska.—30 cents, postpaid.*

THE MECHANICS OF INSTANTANEOUS ACETATE RECORDING, by Sam W. Hawver, deals with a system of sound recording which makes it possible for anyone to engage in the business or hobby of sound recording at a reasonably low cost. *Cellutone Record Manufacturing Co., 1135 West 42nd Street, Los Angeles, California.—50 cents.*

SAFETY REGULATIONS gives rules governing qualifications of employees and safety of operation and equipment of common carriers and contract carriers by motor vehicle. *Superintendent of Documents, Washington, D. C.—10 cents (coin).*

# Books SELECTED BY THE EDITORS

ON YOUR GUARD!

*By Carl Warren, B.S., M.S.J.*

A PRACTICAL book, mainly about the two great "hush-hush" diseases, gonorrhea and syphilis. In recent months a nationwide campaign has been afoot, and is rapidly gaining velocity, to clean up syphilis, a disease which has been costing human society billions. It has been clearly shown that a disease that was regarded as almost hopeless a generation ago is now curable, and that there is hope of largely whipping it out of the race, much as yellow fever was whipped out. The chief obstacle to such a clean-up has been some kind of short-sighted prudery, forbidding public mention of the word "syphilis," hence we still have the disease with us, for it is impossible to educate the public when it is impossible to talk to the public. "On Your Guard" is a decidedly practical book telling the essential facts about the two so-called "social" diseases, how to guard against them (practical and definitive, not merely a lot of generalizations) and how they are scientifically treated today. It has an introduction by M. J. Exner, M.D., Director of Sexual Education, International Committee, Y. M. C. A., who was in charge of social hygiene education for the U. S. Army during the World War. This book is not hard boiled or cynical, but neither is it mollycoddle. It is a book you could offer your boy of high school age, provided you believe he should know the realities of the world in which he will have to live, and will not necessarily be always a plaster saint when out of your sight.—$1.15 postpaid.—*A. G. I.*

PHOTOGRAPHY

*By C. E. Kenneth Mees*

PROBABLY no single art has had such an extensive effect on so many phases of human endeavor as has the art of photography. Dr. Mees, who has been actively identified with the development of this art, has produced the present book in non-technical language and has succeeded admirably in giving the reader a review of photography in all of its aspects. A short chapter is devoted to the historical side of photography and then the reader is carried directly into the up-to-date angles of the art. He is taken into the factories and shown how photographic materials are produced and is then taken to the dark-[illegible] materials during processing. Motion-picture photography is dealt with at some length and so also is color photography. While this is no instruction book for the amateur photographer, it is one that the advanced amateur cannot afford to miss because of the broad background which it supplies. The book is lavishly illustrated with photographs and drawings pertinent to the text.—$3.15 postpaid.—*A. P. P.*

THERE IS FUN IN GEOMETRY

*By Louis Kasper*

WHILE this small volume has been promoted as a collection of brain-twisting, temper-teasing problems, it is really a more practical book than it is an entertaining one. Some mathematically-minded people will, of course, enjoy playing with the 50 complete geometrical problems which are included; many more people will find use in mechanics for these same problems. The solutions are fully worked out in such a manner that they are easily understandable to anyone with a little background in mathematics. Well illustrated with drawings.—$1.90 postpaid. —*F. D. M.*

BAYLEY'S CHEMIST'S POCKET BOOK

*Edited by Robert Ensoll*

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THE RADIO AMATEUR'S HANDBOOK

*14th Edition*

EVERY year there is added to the literature of short-wave radio a book that has always been outstanding in the field. This is it for 1937. Radio amateurs and others interested in short-wave communication will find here the cream of all information on the development of the radio art during the last year. It covers such things as getting started in the amateur radio hobby, fundamental electrical principles, radio circuit principles, receiver and transmitter design, assembling and operating [...] pendix gives many useful tables and data and a comprehensive index completes a really worthwhile contribution to the literature of radio communication. —$1.00 postpaid; $1.25 outside continental U. S. A.—*A. P. P.*

PEARY

*By William Herbert Hobbs*

PROFESSOR HOBBS, the author, gives us a complete biography of Admiral Peary and, as Hobbs has himself been an explorer and is a scientific man (geologist), his account of Peary's many endeavors is written from that point of view rather than from the usual literary point of view. Admirers of Peary will appreciate this excellent work which is illustrated with maps, halftones, and drawings.—$5.20 postpaid.—*A. G. I.*

THE MARCH OF CHEMISTRY

*By A. Frederick Collins*

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*By Jan Vojáček, Dr. Ing.*

UNDER this title there has been published the monograph which was awarded the first prize of the Linthicum Foundation Competition. The author of the monograph is a leading European patent attorney and well known writer on patent law. The procedure govern-

eign countries as well as the United States, and the rights and remedies after the grant of patents, is clearly yet briefly outlined. There is a survey of the laws giving the various acts covering the grant of patent protection and a comparison of the systems of the various countries. Everyone interested in patent law, and particularly the laws of countries foreign to the United States, will find this book helpful.—$3.15 postpaid. —*C. E. H.*

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*Paul Karlson*

BOOK after book on modern (atomic) physics has been written. Of the whole long procession this seems to be the most readable, the simplest, and perhaps the clearest. It comes the nearest to making modern physics easy for the tired business man who doesn't want still more hard labor but longs, instead, for yawnless, workless work. The author's racy, chatty, occasionally humorous, conversational style greatly facilitates easy, painless absorption of the facts of physical science. He covers matter, electricity, light, relativity, quanta, and atomic theory in 281 very friendly pages with simple illustrations. —$3.20 postpaid.—*A. G. I.*

IN 1936

*By A. C. Eurich & E. C. Wilson*

MOMENTOUS events of the year 1936 are covered in this new kind of review. This is a running comment on world politics, business, crime, and international affairs, and though it makes easy and interesting reading, is somewhat in the nature of a permanent reference volume for the library. It is dramatic, terse, and clear in its presentation of facts about 1936.—$2.65 postpaid.—*F. D. M.*

LEICA MANUAL

*By Willard D. Morgan and Henry M. Lester*

AN instruction book particularly designed for users of a specific miniature camera was first published in 1935 and now appears in a second and revised edition. Although the Leica camera is the basis upon which this book is built, most of the material in it, covering all phases of miniature camera work, will be of value to the advanced amateur photographer regardless of what type of camera he may use.—$4.20 postpaid.—*A. P. P.*

FROM FOREST TO FURNITURE

*By Malcolm H. Sherwood*

LOVERS of furniture and those who are interested in timbers of unusual kinds will enjoy this book—unless perchance they already know the subject of wood quite well. It is subtitled "The ... of wood—two thirds of them exotic—in as many chapters of friendly, informative writing. A furniture collector would find it a valuable work to possess. Its emphasis is on the beauty of woods.—$3.15 postpaid.—*A. G. I.*

CALCULATION AND INTERPRETATION OF ANALYSIS OF VARIANCE AND COVARIANCE

*By George W. Snedecor, Prof. Math., Iowa State University*

GENERALIZATIONS from limited data are always subject to uncertainty and are valid and unambiguous only if the data utilized are capable of yielding unbiased estimates of the desired effects and measures of the uncertainties involved. By showing *how* to analyze data, the author indicates *what* data can validly be analyzed.—$1.10 postpaid.—*C. E.*

AN ELEMENTARY CHEMISTRY

*By A. H. B. Bishop and G. H. Locket*

A NEWLY published text book of college preparatory chemistry, as taught in England. It gives evidence that the British lads get a good solid dose of chemistry. Typical "exam" questions, given in an appendix, permit comparisons in stiffness to be made.—$1.90 postpaid.—*A. G. I.*

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*Edited by Pay-Lieut. Comdr. E. C. Talbot-Booth, R. N. R.*

THIRTY-THREE models of existing steamships are shown in this volume, together with drawings of the profile and plan and a complete discussion of each, giving the details of the superstructure and deck arrangement. For those who ride the ship model hobby, this is an excellent volume.—$1.65 postpaid.—*F. D. M.*

WHITTLING AND WOODCARVING

*By E. J. Tangerman*

IT appears, at least from the advertisements of cutlery people, that whittling and woodcarving are coming back as serious hobbies. This volume proves it. Starting with a discussion of how to make the simplest toys and gadgets, trinkets, and wood chains, it proceeds to discuss the carving of human figures, elaborate chests, plaques, designs, and moldings for furniture. It is indeed a

study of an art. Numerous illustrations showing procedure and the results of hours of painstaking work are scattered throughout the book. There is, of course, a discussion of knives and other tools for woodcarving, as well as a table of 182 kinds of wood with the physical characteristics of each. 293 pages, 450 illustrations.—$3.25 postpaid.—*F. D. M.*

### LEICA 1937 ANNUAL

*Henry M. Lester, Editor*

OF photographic annuals there is little that can be said that has not been said countless times before. This is another one replete with examples of all types of photography done with miniature cameras.—$3.15 postpaid.—*A. P. P.*

### RELATIVITY THEORY OF PROTONS AND ELECTRONS

*By Sir Arthur Eddington*

"IN this book," the author says in his preface, "I have endeavored to give a connected account of a series of investigations in the borderland between relativity theory and quantum theory. It begins where my earlier book, 'The Mathematical Theory of Relativity,' leaves off—at the point where in our survey of nature we encounter the phenomenon of atomicity."

Those few among amateur readers who have successfully conquered the earlier book named will be in a position to "surround" the content of the new one, provided they enjoy a good heavy dose of higher mathematics and know their advanced physics. We mention this fact in order to protect unsuspecting readers who might otherwise think this was another of Eddington's popular books. It positively isn't!—$5.75 postpaid.—*A. G. I.*

### TIME AND ITS MYSTERIES

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FOUR noted men of science contribute to this 94-page volume transcripts of popular lectures delivered by them at New York University: Millikan, the physicist, on "Time"; Merriam, the paleontologist and head of the Carnegie Institution, on "Time and Change in History"; Shapley, the astronomer, on "The Lifetime of a Galaxy"; and Breasted, the historian, on "The Beginnings of Time-measurement and the Origin of Our Calendar."—$2.15 postpaid.—*A. G. I.*

### INGENIOUS MECHANISMS FOR DESIGNERS AND INVENTORS, VOLUME II

*Edited by Franklin D. Jones*

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### GEAR DESIGN SIMPLIFIED

*By Franklin D. Jones*

"RULES, Formulas and Examples Applying to all Types of Gears" —this book's subtitle—just about explains its content and purpose. To many mechanical engineers and draftsmen this material is old stuff but they will find it of great value as a reference, for the volume covers in very close detail every step in the design of all types of gears in general use today. Numerous tables and the mathematics for each type of gear are given.—$3.15 postpaid. —*F. D. M.*

### SHADOWLESS FIGURE PORTRAITURE

*By Fred P. Peel*

ONE of the newer phases of photography is so-called "shadowless lighting" in which the source of illumination is such that a minimum of shadows are present in the reproduction of the subject. The technique is evolved through the use of high key lighting in an endeavor to attain delicacy of texture and particularly a pleasing quality in flesh tones. Shadowless lighting requires specialized equipment and in the present book the author not only shows excellent examples of this particular technique but also gives specific directions for the construction of lamp housings of special types for the work under discussion.—$2.90 postpaid.—*A. P. P.*

### HOUSE-FLAGS AND FUNNELS OF BRITISH AND FOREIGN SHIPPING COMPANIES

*Drawn and Edited by Pay-Lieut. E. C. Talbot-Booth, R. N. R.*

HERE we have primarily a book for identification, showing in color most of the steamers on the seas today—some from each nation—while the house flags of several hundred important shipping lines are also shown in color in combination with a picture of the design on the funnels. Shipping people will find this an invaluable reference.—$2.65 postpaid.—*F. D. M.*

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# LEGAL HIGH-LIGHTS

## Patent, Trademark, and Related Legal Proceedings That May Have a Direct Effect on Your Business

By ORSON D. MUNN, Litt.B., LL.B., Sc.D.
New York Bar
Editor, Scientific American

### Design for Dying

In a recent case involving a design for a tombstone, the United States District Court for the Middle District of Pennsylvania discussed the distinction between design patents and copyrights.

In that case the plaintiff was the owner of a copyright on a design for a tombstone which the defendant was alleged to have infringed by selling a tombstone embodying the copyrighted design. The defendant contended that a copyright was not the proper type of protection for a tombstone and that the plaintiff should have secured a design patent. The court disagreed with the defendant, however, and held that it was a proper form of protection for the design and that the defendant had infringed it.

This case exemplifies the type of subject matter which gives rise to the question as to whether it should be protected by design patent or copyright. The copyright statute is intended primarily for the protection of works of art, such as the creations of an artist, or writings of an author, while the design patent law is intended to afford protection for ornamental designs of articles of manufacture. There are many cases in which it is difficult to determine whether the subject matter is a pure work of art or an article of manufacture. In such cases, the courts usually hold that the author or inventor may secure either type of protection but that he can not secure both types of protection.

In the case under consideration the court found that it was difficult to determine whether the tombstone should have been protected by a copyright or by a design patent. It then stated: "In a case which comes under either statute it becomes a matter of choice by the author or owner whether he will seek protection under the patent or copyright law."

### Sky High

THE doctrine that the owner of real property owns from the center of the earth to the sky has frequently been announced by American and English courts. If this doctrine were carried to its ultimate conclusion, it would seriously interfere with modern air travel; an airplane passing over a man's property would be in the same position as an automobile riding over the front lawn. Under this view the airplane operator would be a trespasser upon the owner's property and the owner should be entitled to restrain the trespasser and to collect damages.

The doctrine originated prior to the days of air travel and never appears to have been applied by a court in a manner to prevent air travel through the space above a man's property. A Federal Circuit Court of Appeals recently had occasion to pass upon the application of this doctrine to airplane travel.

The owner of a strip of real property adjoining an airport brought suit against two airplane transport companies for damages and an injunction, alleging that the companies had trespassed on the owner's property rights by flying airplanes over his property at heights varying from five feet to one hundred feet. The owner contended that he owned the stratum of space overlying his tract of land and that the action of the transport companies in flying their planes over his land interfered with and trespassed upon his rights.

The court rejected the plaintiff's contention and refused to construe the doctrine outlined above in such a manner as to prevent the transport companies from flying their planes over the plaintiff's property. In this connection the court stated that the doctrine merely meant that the owner of the land could use the overlying space to such an extent as he was able and that no one could ever interfere with that use, concluding with the remark:

"We own so much of the space above the ground as we can occupy or make use of in connection with the enjoyment of our land."

This decision would appear to be a practical one as airplane travel necessarily entails flying over the property of many different people. If such travel constituted a trespass on the rights of the owners of the property beneath the line of travel, it would be necessary for the airplane operator to make satisfactory arrangements with all of the property owners, which of course would be a physical impossibility.

### Disclose Completely

IF YOU decide to patent an invention, make sure that your patent contains a complete disclosure of the invention.

Occasionally an inventor only partially describes his invention in a patent, retaining the remainder of the invention as a secret, and in that way believes that he has adequate patent protection and also the additional protection afforded by keeping an important portion of his invention in secrecy. Nothing could be further from the truth. In most instances the failure to disclose the invention completely in a patent results in an invalid patent.

The Patent Statute requires that the invention be described "in such full, clear, concise, and exact terms as to enable any person skilled in the art or science to which it appertains, or with which it is most nearly connected, to make, construct, compound, and use the same." The reason for this is found in the fundamental theory underlying our patent law.

The government affords to an inventor a monopoly on his invention for a limited period of time in return for a complete disclosure by the inventor to the public so that upon the expiration of the monopoly the public may be sufficiently informed to practice the invention.

An example of results flowing from failure to disclose completely an invention is to be found in the recent case decided by a Federal Court, in which the plaintiff brought suit for infringement of a patent on a moving picture screen. Among other things, the patent stated that the screen should be provided with perforations of sufficient size and number to permit passage of sound waves therethrough without blurring, while at the same time preserving the light reflecting properties of the screen so as to make it efficient for the presentation of pictures. The patent did not describe the exact number or size of the apertures, but merely concluded that they should be such "as to yield results of the character demanded by a critical public."

The court found that this did not constitute a complete disclosure and that the public was required to experiment in order to ascertain the nature of the apertures to be provided. It concluded that the patent was invalid, stating that "if the description be so vague and uncertain that no one can tell, except by independent experiments, how to construct the patented device, the patent is void."

### An Explosive Problem

THE uninitiated layman may regard toy torpedoes and salutes as very similar forms of fireworks but a federal court recently had occasion to distinguish between them. In a suit for patent infringement brought by one fireworks manufacturer against another, the plaintiff contended, among other things, that a toy salute manufactured and sold by the defendant infringed plaintiff's patent on a toy torpedo.

Each of the claims in the plaintiff's patent related specifically to a torpedo or to a method of making a torpedo. The defendant made a salute in a manner similar to the torpedo described and claimed in the patent. The court, however, held that the salute did not constitute an infringement of the patent on a torpedo. In reaching this conclusion the court pointed out that a torpedo is actuated by impact while, on the other hand, a salute is caused to explode by ignition of a fuse projecting from inside the salute. The decision was based upon the principle of patent law that where a patentee intentionally limits the scope or field of coverage of a claim, he is bound by the limitations in the claim and cannot later attempt to expand the interpretation of the claim beyond the field originally selected. In this connection the court said:

"Here it is too clear for argument that, by both the claims and specifications, the patentee was not claiming an improvement for pyrotechnic devices generally, but was intentionally limiting his improvement to a specific and particular species of minor fireworks, a torpedo."

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The
SCIENTIFIC AMERICAN
DIGEST




# SCIENTIFIC AMERICAN

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NINETY-THIRD YEAR • ORSON D. MUNN, Editor


## CONTENTS · MAY · 1937



As pointed out so ably by Mr. Kettering in his article, "Research and Industry," starting on page 285 of this issue, research is the life blood of any industry that is constantly searching for new products and new uses for old products. Symbolical of industrial research is our cover photograph showing an assemblage of laboratory equipment in preparation for the vacuum distillation of an essential oil in the research laboratory of Givaudan-Delawanna, Inc.


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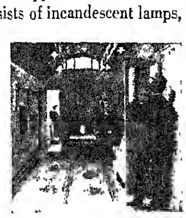
# 50 Years Ago in . . .

# Scientific American

*(Condensed From Issues of May, 1887)*

PANAMA CANAL—"The prospects for a canal at Panama seem more illusive as time goes on, and not even the skill and perseverance of the French engineers has, so far, sufficed to lend to the scheme the air of practicability."

CAR LIGHTING—"The apparatus (for the application of the electric light to the illumination of cars) consists of incandescent lamps, supplied by storage batteries of the Julien type. A number of cars, sleeping, parlor, and ordinary ones, and even a baggage car, are now thus lighted, and it is fair to assume an extensive introduction of the system. The public attention has been so forcibly drawn to the dangers of kerosene lamps on railroads, that special interest attaches to the subject of the electric lighting of vehicles of travel."



VACUUM ENGINES—"In the central station of the Rue de Beaubourg, Paris, a 40 horse power plant is now at work actuating vacuum engines in the neighborhood, some of them being situated at a distance of about a third of a mile. Motive power at the central station is provided by a steam engine, which works an air pump producing a partial vacuum in a system of small lead tubes laid underground throughout the district. At the different places where power is required, there are small vacuum engines constructed similar to steam engines."

SUB-SEA—"A writer in one of our contemporaries suggests the development of submarine navigation as one of the works of the future. He contrasts the amount of time and thought which has been expended upon the solution of the problem of flight with the little that has been done in the other field."

DOMESTICATED APES—"The ideas of M. Victor Meunier with regard to the domestication of apes are discussed in the new number of the *Revue d'Anthropologie*, by Madame Clemence Royer, the French translator of Darwin. Madame Royer does not doubt that, under a proper system of training, apes might be made good workers. They lack perseverance, indeed, but in general intelligence they are, she thinks, superior to the dog, the horse, or even the elephant."

GAS WELL—"The largest gas well in the world has just been discovered at Fairmount, Indiana. The tests of Professor Orton, State Geologist of Ohio, show that it is flowing nearly twelve million cubic feet per day."

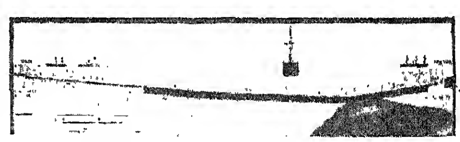
OVERHEAD WIRES—"The city of New Orleans is about to adopt a system of Colonel Flad for overhead wires. This consists in erecting tall towers at the street corners, which will carry the wires over the roofs. . . . The older method of running the wires, telegraphic, telephonic, and electric lighting, on poles will be abolished."

SHOES—"The London (Eng.) *Shoe and Leather Record* describes a system of fastening the soles to boots and shoes, in which the fastenings are driven from the inside, the fastenings being first placed in the insole and then the upper lasted over them."

ASBESTOS—"From Orenburg to Ekaterinburg, Russia is declared to be thickly dotted with asbestos deposits, while near the Verkni Tagil iron works is a hill called the 'Sholkovaya Gora,' or Hill of Silk, which is stated to be entirely composed of asbestos. . . . In the Goroblagsdat district of Perm similar deposits crop above the surface, and any quantity can be obtained for nothing, the mineral possessing no value in the Ural region."

RAILROAD BRIDGE—"The Central Railroad of New Jersey crosses Newark Bay upon a trestle nearly two miles long. Near the eastern end of the trestle is a draw span which, after having performed its duty for many years, and been re-enforced to enable it to accommodate heavier loads, is now being replaced by one more in keeping with modern practice, and better proportioned to carry the heaviest engines now built, and to provide for any increase that may take place in the future" (!)

HUDSON TUNNEL—"In some respects a most remarkable piece of submarine engineering was that begun some twelve years ago, when the first work connected with the tunnel to unite Jersey City and New York by a passage under the bed of the Hudson River was done. Important to the engineer because of its vast magnitude, the difficulty and danger attending its prosecution, and particularly because of the new methods of working introduced; important to commerce, as it would afford a quick and sure means of crossing the river, and would reduce the time between New York and the South and West on each of the great railroads terminating at Jersey City."



FERTILIZER—"The great value of nitrate of soda, a material our cultivators are only beginning to learn the value of, is to hasten the growth of plants early in the season, and for this purpose it has no equal."

CONSERVATIVE MILITARISTS—"Military authorities are by no means agreed that the magazine rifle is superior to the breech-loader for the use of the soldier; and though Europe is hurriedly exchanging the former for the latter, the voice of indignant protest is making itself heard in the military journals, and with no uncertain sound."

PARCEL POST—"The public will be greatly benefited if the scheme, now under consideration by the Hon. A. W. McLelan, Postmaster-General, for creating a parcel post system between Canada and the United States, materializes. At present there is no system whereby parcels can be sent direct."

**AND NOW FOR THE FUTURE**

**For men only: Pogonotomy—shavers and shaving, by E. J. Casselman**

**Unique constructional features of the Storström Bridge in Denmark, by R. G. Skerrett**

**Life frequently persists in spite of adverse circumstances, by T. Swann Harding**

**Speed a-wing—how fast can birds actually fly?, by S. F. Aaron**

**Another intriguing article on archeology, by Jotham Johnson**

# *Personalities in Science*

THOMAS MIDGELY, JR.

FOR distinguished work in applied chemistry, including the development of anti-knock motor fuels and of non-toxic, non-inflammable refrigerating fluids for household refrigerators and air conditioning, Thomas Midgely, Jr., vice-president of the Ethyl Gasoline Corporation, has been awarded the famous Perkin Medal.

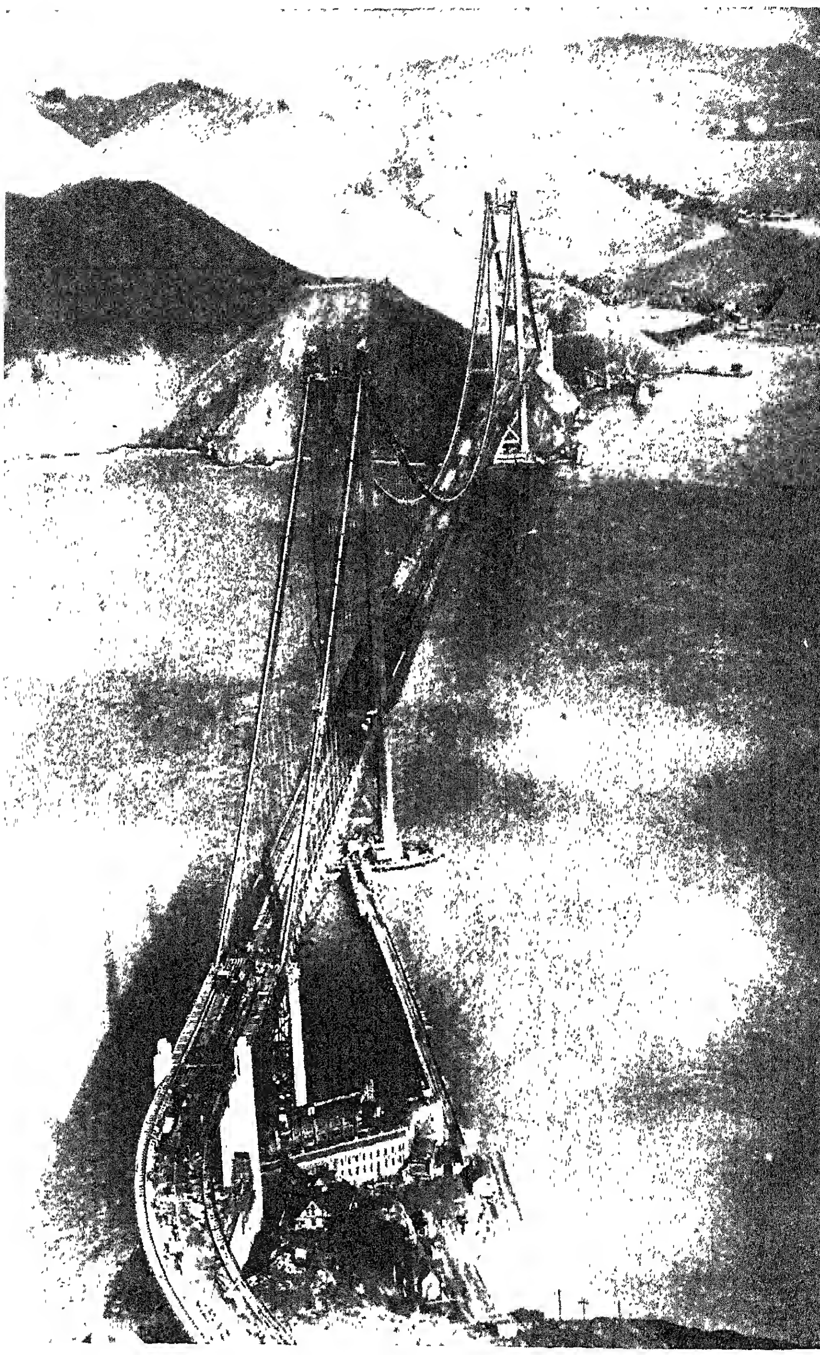
At a joint meeting of the American Section of the Society of Chemical Industry and the New York Section of the American Chemical Society, Robert E. Wilson, vice chairman of the Pan American Petroleum and Transport Company and since youth a personal friend of the medalist, spoke informally as follows:

"Midgely decided to take a course in mechanical engineering at Cornell University. I am sorry that I cannot report that he was an all 'A' student—in fact it appears from both his testimony and that of his professors that the ideal of efficiency which has always been uppermost in his mind demanded that he do the minimum amount of work with which he could get by in most of his courses, so that he could concentrate on a few things which were really of interest to him.

"Having heard much of the fame of Charles F. Kettering while still with the National Cash Register Company, he got a job with the Delco Light Company and thus began in 1916 his long and fruitful association with Mr. Kettering. It so happened that his first task was that of trying to get more power out of the small Delco Light units when they were operated on kerosene. It had been found that, operating on gasoline, the compression on these engines could be raised to a point where they gave fairly good power output and efficiency, but when an attempt was made to use these compressions with kerosene as fuel, severe knocking and even cracked cylinder heads resulted. Tom became much intrigued with this phenomenon, and, wanting to study it more closely, rigged up a high-speed indicator using a system of optical levers for magnifying and recording the shape of the pressure wave. This eventually led to the perfection of the Midgely indicator, which did so much to throw light on just what took place when engines knocked, indicating, among other things, that knocking and pre-ignition were two entirely different phenomena.

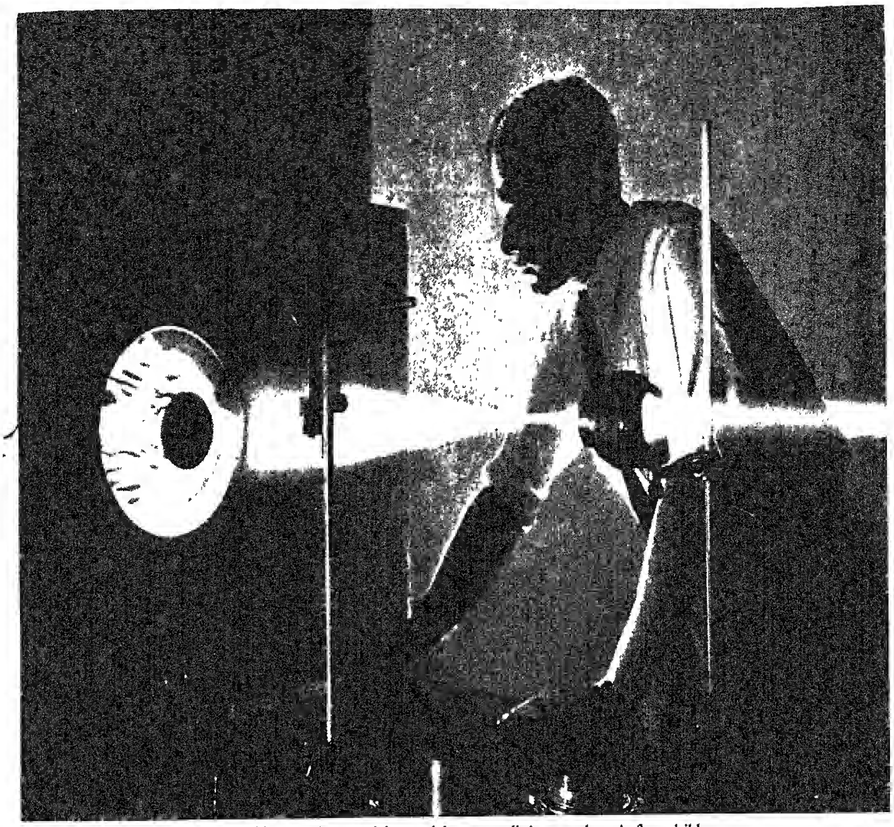
"The Midgely indicator showed clearly that the knock was due to a rapid rise in pressure after ignition and near top dead center. In attempting to theorize as to why kerosene knocked and gasoline did not, he first seized upon the most obvious difference between the two products—that of volatility—and thought that possibly the kerosene vaporized rather slowly until after combustion started and then vaporized very suddenly with a resultant too-rapid explosion. If this explanation were correct, he reasoned that by dyeing the kerosene it might be possible to make the droplets absorb radiant heat from the cylinder walls and hence vaporize sooner. While this theory proved to be entirely unfounded, it did lead to the discovery of the anti-knock properties of iodine, and started him on the trail of a whole series of anti-knock compounds culminating in tetraethyl lead, the basis of ethyl gasoline.

"Tom's other outstanding discovery was, of course, the development of certain organic chloro-fluorides as the only refrigerants which are at once stable, non-toxic, and non-inflammable. Again this particular discovery is merely a symbol of the many special problems for General Motors and its affiliated companies to the solution of which Tom has devoted his talents, and by which he has proved that neither the discovery of tetraethyl lead nor that of Freon was an accident but rather the result of real chemical ingenuity and intuition, plus a lot of hard work and horse sense. Who would have dared to imagine that a stable, non-toxic, non-inflammable refrigerant could be made in effect by combining a highly inflammable gas, methane, with two of the most toxic gases known, chlorine and fluorine, yet that is the accomplishment which has done more than any other one thing to make home cooling installations safe and popular."



## LOOKING NORTH ACROSS THE GOLDEN GATE

THE Golden Gate Bridge (see also page 301) as a definite project dates back to 1919, when the San Francisco Board of Supervisors authorized a survey to determine its feasibility. Preliminary plans were prepared and the project was approved by the War Department in 1924, but it was not until six years later that the Golden Gate Bridge and Highway District was formed. The bridge has been built as a self-liquidating project, being financed by a \$35,000,000 bond issue, guaranteed by the taxable property of six Californian counties—San Francisco, Marin, Sonoma, Napa, Mendocino, and Del Norte.


The Schlieren effect, used for studying streamlining, renders air flow visible

# RESEARCH AND INDUSTRY

## No Research Holiday . . . We Think Engineering is Ahead Because it is a Lap Behind . . . Has Much to Learn . . . Fallacies of Technological Critics

By CHARLES F. KETTERING
Vice President, General Motors Corporation, and Director General Motors Research Laboratory

THERE has been a lot of talk in the last few years about research and scientific development, most of it of an extremely derogatory nature. When it wasn't derogatory, it was pitying. "We've reached the end of our rope in inventing new things. From now on we'll only improve the methods of making these things by machinery and throw more men out of work. We have come to a point in our civilization where research can only make things worse."

That is a theory I would hate to believe, even if there were truth in it. And I do not believe there is a word of truth in it. The facts seem to belie it.

We have been through some lean years recently, and it cannot be denied that unemployment is still a problem. The engineer is often blamed for this lack of jobs, this "technological unemployment," perhaps because there are not very many engineers to talk back. But I don't feel that the engineer is to blame for these conditions. At least, if there is any blame attached, it is for what the engineer did not do, not because he did too much.

A great many people apparently feel that industrial research has pushed forward too fast; as they phrase it, it has gotten ahead of our social absorption ability. To my mind, that is about like the man who went down to take the train at the scheduled time and found it had left an hour earlier. He was naturally quite irritated, but his protests availed nothing, as the railroad company's defense was that it was yesterday's train which had just pulled out, only 23 hours late. I think that may be the reason we think engineering is ahead—it is a lap behind.

With all the talk about the trouble created by technologists through the development of labor-saving machinery, it is peculiar that so few people have realized—or perhaps I should say, have expressed the realization—that a technological development may have much greater possibilities for labor-creating than for labor-saving. It is often asked if we would not be better off without some of this development which has taken work away from men and given it to machines. But how often do you hear anyone suggest that if we extended and multiplied this work of develop-

ment it might create new industries which would more than absorb any people who may have been thrown out of work due to it?

I am, of course, more familiar with the history of the automobile business than with any other, so let us take that as an example. Some thirty-odd years ago I had a canvass made of the number of people in the automobile industry. As closely as we could figure, it was about 1000. By the best figures we can get today, about 11,000,000 people are directly, or indirectly, dependent on this industry for their livelihood. These are certainly not all in the business of building automobiles, but that is not the motor-car industry. A large percentage of the steel produced goes into the automobile. A great deal of our glass, a still larger percentage of our rubber, and an extremely large percentage of our petroleum—all this added together is the motor-car industry.

NO one thought when he was making the old one-lung machine that he was beginning something which would some day be one of the leading industries of the world, would contribute to practically every industry known at that time, and directly or indirectly be responsible for the creation of many new industries and many drastic changes in the living habits of thousands of people. You can't tell what is going to happen to an idea, what it may lead to in the future. But we do know, if it serves a purpose, it will develop into an industry.

Let us take another example with which you are all familiar. The caveman knew how to make heat, even fire, by rubbing two sticks together. But it was a long time before man learned how to make cold. Finally, this was done in laboratories, and the first commercial use to which it was put was the manufacture of ice. This was a natural extension of an existing business, which brought the benefits of refrigeration to great numbers of people who previously could not afford them. Then somebody built a cold-storage plant, which was simply a large refrigeration unit. This was a new industry. Then this was changed around and produced in midget sizes, and began to appear in kitchens all over the world. Here is another new industry, a giant one.

Incidentally, it is interesting to note that these giant industries generally come into being as the result of someone taking a large mechanism and reducing it in size and price so that everybody can buy it. Doing exactly this is a very definite feature of American progress.

Then somebody, considering the sad state of the motion picture business during the summer season, when the theaters were either closed or doing a skimpy business hardly worth while, had the idea of installing a particular kind of refrigerating machinery for cooling the air coming into the building. This was just a particular adaptation of the same old discovery that man could control temperatures well enough to make ice. Making ice simply happened to be the first use to which it was put, principally because people already knew what ice was and what it could be used for. It would have been just as possible for air conditioning to come first, with refrigeration following afterward.

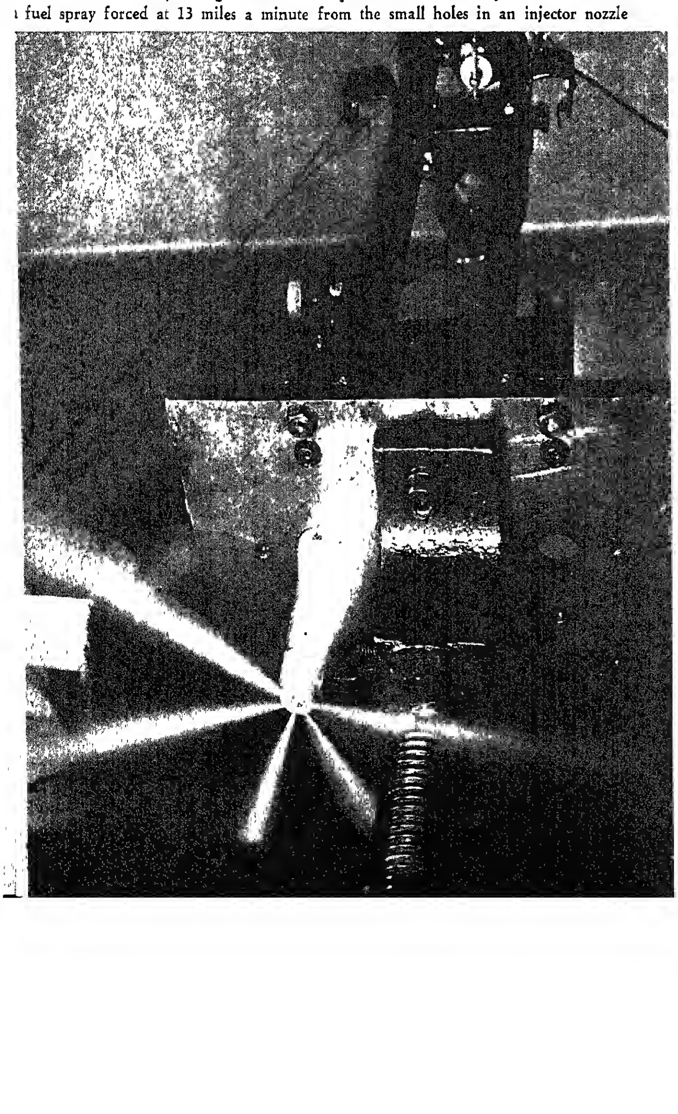
From the theaters, this air conditioning business spread to the department

Equipment for making photomicrographs

stores, creeping up floor by floor, and then into hotels and restaurants. Then some live engineer conceived the idea of putting such a mechanism on a train; and as this was rapidly taken up by various companies, it was possible to see a definite increase in rail travel. Formerly you couldn't have hired me to travel across the desert in the summer months by rail, but now this can be done with the utmost of ease and comfort. You may ask what the next step is going to be in the air conditioning business. I cannot help but think that it will follow the same path as refrigeration and numerous other developments. It will be turned out in midget sizes, the price will come down, and the comfort and benefits of air conditioning will be made available to great numbers of ordinary people throughout the world.

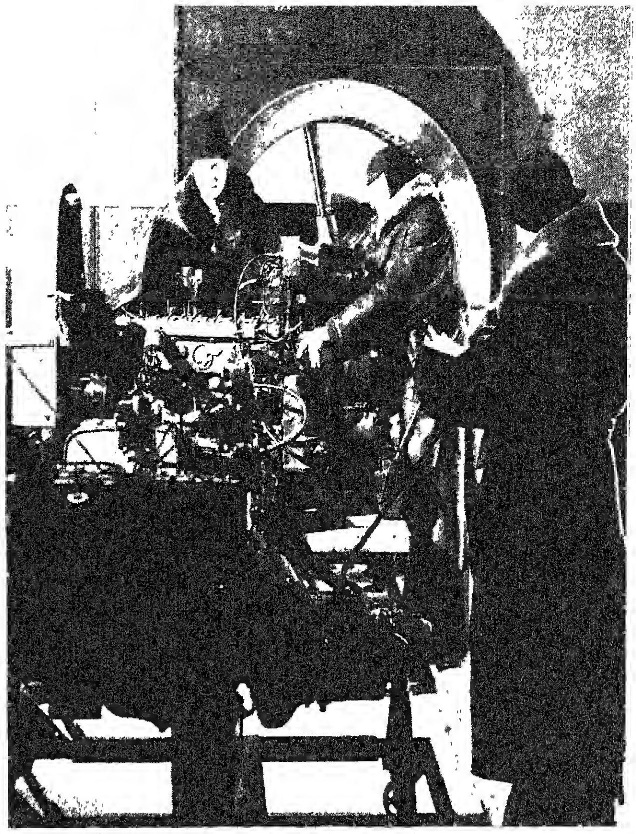
Of course, all industries do not grow

Much research is always being done on the important Diesel fuel injector. Here we see a fuel spray forced at 13 miles a minute from the small holes in an injector nozzle



so fast, but on the other hand some are full grown almost before we realize there is such an industry. With all our past experience, it is impossible for us, even those intimately connected with a certain line of business, to forecast what developments will be forthcoming in the next few years. In the automobile business, highly organized as it is, I have never seen anyone successfully prophesy what was coming two years ahead. And when people ask, "What will the new great industries be?" the only possible answer is, "Nobody knows." You can't recognize a great industry when it starts, particularly as there may be some small detail lacking which will hold up its development until that is taken care of.

One important duty of the engineer at the present time is to give the man responsible for the financial end of the



Cold starting problems are studied and work on manifolds, automatic chokes, and carbureters is carried out in this Cold Room, which can be cooled to 50 degrees below zero

of the crystalline structure of metals

business a better picture of the workings of research and scientific development. I think perhaps we have become too expert bookkeepers. We do not know how to spend money without its being incorporated on the profit and loss statement. We do not know how to spend money wisely on the development of a new idea or principle. Ninety-nine percent of our business is set up on the books with the cost of each piece set down and every penny allocated to this or that item. Then when you come to something like a research laboratory, it is difficult to convince the accounting department that they cannot say, "Now this will cost so much. We will make a profit of X dollars on that project."

Of course we don't object to an accounting system. It is a very necessary part of any business but research needs a different kind of a system. There is a gap between a fundamental idea and a commercial product, and the development during that period cannot be put in a profit and loss statement. A great deal of money has been spent in research on developments which never became commercial, and others have become the basis of whole new industries; and you never can tell from the looks of the project at the beginning what it may turn out to be.

The gap between the technologist and the management, or financier, seems to be widening. The engineer is becoming a better calculator, and consequently he doesn't carry his experimental work and model building as far as was customary in the past. On the other hand, industry has become more standardized, and a better model than before is wanted. So the gap is extending at both ends. That zone between the idea and the finished product I call, for want of a better name, the "shirt-losing" zone. That is the place where, if there is not proper management, proper engineering, and proper study, a great deal of money can be spent with no future profits to make it up. It is the fear of this zone that makes the management shy away from new developments. They would like such projects to jump directly from the initial conception of the idea to a money-making product. I sometimes think that if we tried to raise human children as industry tries to raise brain-children, they would be expected to earn their living at the age of about nine months.

THERE is another system of accounting, however, which is used by one of our largest businesses. This I call "actuarial" accounting. In the insurance business they do not worry about the individual items. They do not follow the individual policy-holder around and tell him what he can or cannot do. All they want is that the grand average of all these policy-holders comes out the way they figured. Therefore we must treat research as an insurance policy, insuring the company against ignorance of what is going on in the world and against lack of future profits. As I have often said, "Research is trying to find out what you are going to do when you cannot keep on doing what you are doing now." On that basis the company appropriates a certain amount of money for research. We agree to take that money and spend it with just as much carefulness and thrift as would be done in the manufacturing end of the business. We cannot guarantee just what, when, or how we will produce anything which means income, but we do claim, and so far experience has confirmed this decidedly, that in the long run the developments will be responsible for profits more than enough to pay the total cost of research.

Charles F. Kettering

Many developments which appear to be unsuccessful are merely awaiting progress in some other field to turn them into an over-night sensation. The first Diesel engine was built over 40 years ago. It could not be called an important development, however, until a very few years ago. Undoubtedly, various things were responsible for its ultimate success, but the progress in metallurgy alone is sufficient to account for a great deal of it. Just to give you an idea of how quickly these changes sometimes occur, I want to mention an incident in the office of Mr. Alfred P. Sloan in August, 1932. When I entered, I was greeted by the chairman of a great railroad, who held up a fat and impressive-looking report.

"This," he said, "will tell you why our engineers think the Diesel engine does not fit the work of railroads."

"Without reading the report, I'll sign it, too," I told him. "It isn't practical—the Diesel engine of today. But there will be new and lighter Diesels."

See how quickly that came true. In April, 1934, less than two years later, the Burlington *Zephyr* No. 1 Diesel-powered train was put into service and in May made its record run from Denver to Chicago. The thing which made this possible was not so much concentrated work on Diesel engines as it was the background of years of work on internal combustion engines in general, particularly some of the effort spent on the fundamentals of combustion.

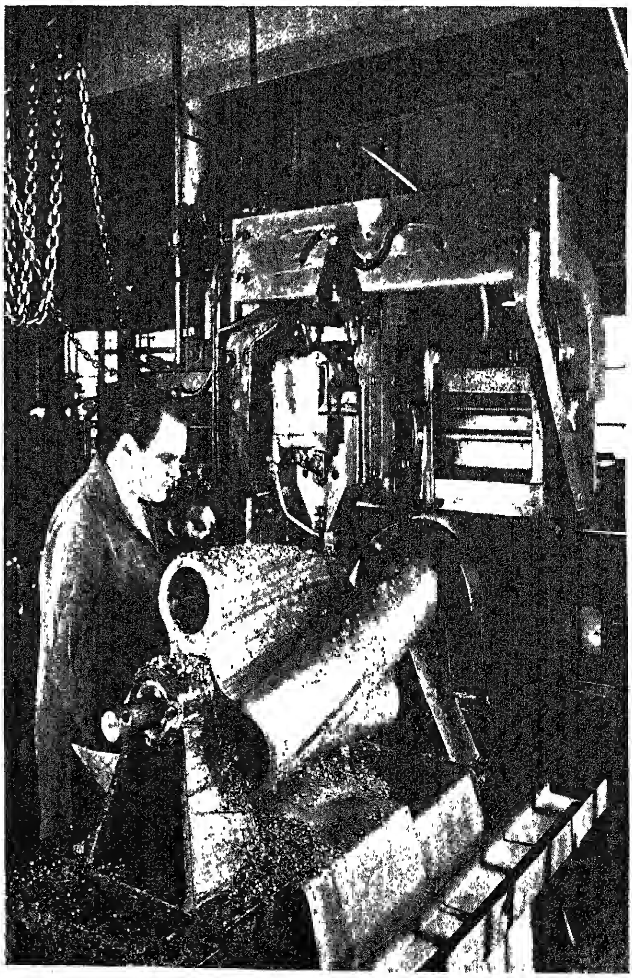
These various examples I have cited have all happened recently, and I could mention a great many more. Now why should these things stop occurring all at once? Just because we don't know what the future developments are going to be, is no reason for saying there aren't going to be any. We keep hearing of all the marvelous things we have learned, but there is very little talk about the things we don't know. A great many of the things we think we know turn out to be simply definitions that we have made up and attached to them. A scientist was asking me one day about some of our problems, and I said: "Here is one problem that has been bothering me a long time. Why can I see through a pane of glass?"

"Why, because it's transparent, of course."

So we looked at a dictionary, and found that something is transparent when you can see through it. Very simple, isn't it? But what does it mean? An old colored fellow summed it up pretty well. He said: "It ain't them things you don't know what gets you into trouble, it's them things you know for sure what ain't so."

Just about the most valuable thing I can imagine would be an analysis, or outline, of what we don't know. We brag about what we do know, but there is nothing with which to compare it. If we could just say, "Here is what we know. Over there is what we don't know," then we would have some idea of what the possibilities are for industrial progress in this country. And I think we would laugh at the tiny little pile of things over here that we know, in comparison with that great block of knowledge on the other side just waiting for someone to come along and hew into shapes useful to the world.

NEW scientific developments will continue to be born. If necessary, they will come out of barns or garrets, but they will appear. The only possible question is how often will they occur and how fast will they grow. That is where organized, or industrial, research comes in. It accelerates the pace of progress. Scientific problems are not solved by a fine new building and expensive equipment; but, with the many different phases of modern research work, there are definite advantages in a group attack on a project. One man can profit by the experience of others. There will always be opportunities to contribute to progress and human welfare, and the industrial research laboratories of the future I feel sure will do more than their share in this direction.



An end-result of research: a special type Root's air blower for a Diesel

# OUR POINT OF VIEW

## Excelsior!

FOR straight thinking, a clarifying vision of future progress, and the delivery of provocative bombshells of logic with which to shatter the delusions of technological defeatists, one strong voice can always be depended upon. That voice belongs to C. F. Kettering, esteemed Director of the General Motors Laboratories, whose article ends on the opposite page.

In recent years we have been treated to an amazing cloudburst of "social this" and "social that" backed by about as much empirical knowledge as a school-boy's first love affair. We have been told by those who have never been in (or near) a research laboratory, who have never sat behind a desk and met a pay roll, who apparently are mentally long-haired and van dyked, that science and engineering have out-stepped civilization. "Mankind must have time to catch up," they say. "The cloistered scientist must assume his responsibility to man and calculate the social consequences of his work." "Declare a moratorium on science." "Put some thought on sociological problems." And so on, *ad goosepimples!*

Why? Why should science even listen? There is no reason why it should but it has because these omniscient critics (of everything but their own theories) are so vociferous and often so highly placed as to lead astray many otherwise sensible people. That is the sorrow of a nation of too-many followers of someone else's thinking.

No need to repeat that science has contributed more to human progress than any other one thing. It will continue to do so despite derogatory remarks from the side lines. If social research is also necessary, let the ideologists perform it; that is their field. The scientist deals with objective facts, not subjective abstractions, though he is, finally, concerned with the subjective phases marked "human progress" and "profits." The sooner we stop giving ear to the talkers and learn to think with the performers, the sooner will those "sociological consequences" fall into their proper place in the pattern of a rapidly evolving civilization.

## Whence Highway Funds?

THROUGH the medium of various forms of taxation the American motorist pays dearly for the privilege of using the highways. In New York State, for example, the average motor-car driver paid a total of $42.97 in taxes during 1935, the last year for which complete figures are available. It is generally assumed that the money collected by means of gasoline and registration taxes will be used for the benefit of the motorist who pays the money. The greatest need to which this money can be directed is better and safer highways. But what happens? To revert again to New York State—and the situation there is typical of that found in many other states—the taxes collected from the average motorist were spent as follows: state roads, $9.36; local roads $7.40; miscellaneous expenditures $1.09; *general purposes $25.12.* It is in this last figure that the injustice of the situation is to be found. We need more highways. We need safer highways. The money is available for both, but it is being diverted for "general purposes" that have nothing whatsoever to do with the motorist as such. Of these "general purposes" the less said the better—from the politician's point of view. One of the many purposes is for relief, and is it not strange that the motorist should be called upon to pay for this purpose a special tax that is levied on no one else?

The average motorist has no objection to paying his fair share of the cost of building and maintaining the highways, but he has, and very rightly, a decided objection to paying taxes that are diverted from the channels to which they have been pledged. He pays the same taxes in other brackets that are paid by the non-motorist, yet he is constantly called upon to dig down and contribute more than his fair share to "general purposes" under the impression that his money is to go for highway and allied expenses.

Ever since the beginning of the development of motor cars for personal transportation, legislators have looked upon the motor-car driver as fair game for purposes of taxation. Gradually taxes climbed—in New York State they increased from $25.34 in 1929 to $42.97 in 1935—but the highways did not increase in anything like the same ratio.

That specialized taxes of the type applied to motorists should be used for purposes other than those for which they were originally designed is one of the detestable features of our method of financing public developments. It is class taxation beyond a shadow of doubt. Only the motorist himself can do anything about the situation and he can act only by pressure brought to bear upon his local legislators. If he would have his specialized taxes reduced or if he would obtain his money's worth for the amount which he now spends, it is up to him to go to bat and fight for his own rights.

## Happy Landing!

"SPECTACULAR" is hardly the word for it, though that word has been used in the announcements; it is that and more. Some might borrow from the circus-barker and call it superlative!, stupendous!, death-defying!, colossal!, but, along with the stark thrills it will furnish to a thrill-mad, gawking multitude, and its inevitable tragedies, it is also silly—silly and useless. We refer to the transatlantic air race scheduled for the month of August to commemorate the tenth anniversary of Colonel Lindbergh's historic flight from New York to Paris.

Briefly, the race will not be plane against plane; the pilot may take off at any time during August and race from New York to Paris against time. Only multi-motored planes equipped with two-way radios may enter. Prize money totalling 3,000,000 francs posted by Pierre Cot, French Air Minister, will reward the victors who may come from 35 countries affiliated with the Fédération Aéronautique Internationale.

There is no question that there will be numerous entries. But what does that prove? Also, numbers of the planes will doubtless reach Paris. Nor will that prove anything of particular importance. A fair percentage will reach Davy Jones' locker. This *will* prove something: that a stunt of this sort is dangerous and that those who participate are foolhardy.

Airplane design, from Pitot tube to rudder, has improved vastly in the years since Lindbergh's perfect achievement. But airplanes are not yet 100 percent trustworthy. These racing flights will not make them more so, will add nothing to our present knowledge of design or operation. They may add something of over-ocean flight knowledge to some of the pilots, for there are likely to be many entries who have had no previous experience over large bodies of water, but is such knowledge worth the great cost that will undoubtedly be the result of this race?

France's fine spirit in wishing to commemorate Colonel Lindbergh's flight with such a large appropriation for prize money (approximately 140,000 dollars) is indeed commendable, but just the same—well, we would prefer something a little less "spectacular" and more enduring.

# BACKSTAGE AT THE ZOO

## Captive Animals Live Longer . . . Fare Better . . . Pampered in Scientifically Designed Settings . . . Zoo Problems . . . Animal Instincts

By WILSON CHAMBERLAIN

RECENTLY an animal lover excitedly told the director of a large zoo that a polar bear had evidently gone mad. The creature was pacing up and down endlessly within a self-imposed limit of five or six feet, apparently too listless even to lift its great paws, which it kept sliding along. But the director only smiled.

"Don't worry," he said. "All polar bears do that from time to time. It's instinct. They think they're on a slippery ice-floe and are being careful not to go too near the edge."

The actions of other animals in captivity are similarly often misunderstood. When brown bears, for example, stand for hours just lifting one paw and then the other, they are merely following an age-old custom of padding down the snow. And it's not fleas that make the monkeys scour each other so intently but a passion for salt which they remove bit by bit from scaly skin, plus an innate vanity for grooming. Actually very few monkeys have parasites.

Don't think that the mere keeping of wild animals in captivity is cruel. The birds you pity in a two-foot cage live much longer than if they were free; and if their cages were larger, they might break their wings. The fox deprived of its freedom to run may make you indignant; but it runs primarily to track food and escape danger; when well-fed and at peace, the fox does not stray from its lair. The elephants you sometimes see tightly chained like that chain. It gives them a feeling of security; if you took it away, they'd trumpet all night in fear. Understanding this instinct, native keepers in India fashion a chain of straw for each of their charges rather than make them pass the night fearing lest their food be stolen and their bed (a source of particular pride) be destroyed by the other elephants.

Of course, in some of the backward commercial zoos, animals are sometimes cruelly mistreated. The remedy for this is regulatory legislation. Indeed, several states have enacted laws forbidding the keeping of animals in captivity without permission and supervision of the Conservation Department. This is doing much to get rid of the iniquitous roadside zoo and the mistreated bear-at-a-filling-station sort of menagerie.

But the well-run zoos have high standards of diet, comfort, and cleanliness. New zoos in Chicago, St. Louis, Toledo, San Francisco, Washington, Buffalo, and a score of other cities are doing startling things.

In Chicago, for example, the air in the lion house is changed every four minutes. The tropical plants you find in some houses are not merely attractive settings; their real purpose is to regulate the moisture. Some zoos go so far as to install electric humidifiers. To keep the penguin cool in hot weather requires 200 pounds of ice a day in their shelter. And when you see a hippopotamus with a baby, thank the zoo man for having built a large enough bath: the hippo breeds and gives birth under water—for security—while the baby nurses under water, going up for air and down for milk. Many zoos have a quarantine section where new arrivals are attended by white-coated doctors who wouldn't dream of not washing their hands before calling on the leopard, lest they infect it. These quarantine cages are deliberately small: after a long sea voyage, an animal's bones are brittle and it is nervous; in a large cage it might rush the bars and break its neck or legs.

COURTESIES to apes and monkeys could fill a book. To insure having strong adults, young chimpanzees in the Chicago zoo get nascent oxygen pumped into their cages to insure the pure air which their delicate lungs need. To make sure they sleep the full 12 hours they are accustomed to in the dark jungle, blinds have been put up outside their sleeping boxes in the zoo at Munich, probably the finest primate house in the world. There each ape has its own blanket, sent to the laundry every week. To check pyorrhea—common in apes—their teeth are brushed daily, while some zoos use concentrated vitamins B and D to combat it. In other zoos, sun lamps are used.

Personal attention is essential for apes. Frequently a chimp becomes listless because it is being tyrannized by the other apes. The leaders are apt to grab the favorite food, like tomatoes, leaving the potatoes to the weaker ones—a tyranny which can be ended only by a keeper's personal attention.

True of all animals, amusement is particularly important with apes. More and more, modern zoos are going to endless trouble to evolve swings, bars and trees to amuse the apes. But while such intelligent advances are being made in some zoos, their large scale adoption is held up by lack of cash.

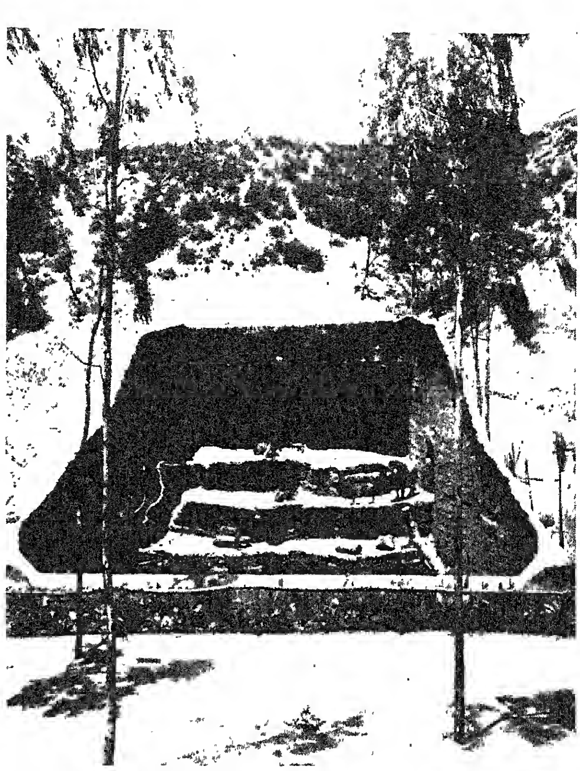
Concrete, for example, is the bane of every conscientious zoo today. When originally installed, it was thought superior to wood. But it is cold, hard, and moisture retaining; the cats get callouses from walking on concrete unless keepers pare their pads frequently. It conduces to arthritis in foxes and tuberculosis in monkeys. Giraffes are apt to slip on it even though you roughen it; in Philadelphia, two fine specimens fell and died of broken pelvis. But to rip out concrete floors and install the sort of silica composition used in Chicago costs thousands of dollars, as do other improvements. In those zoos which have plate glass separating the apes from a coughing public, mortality rates fall phenomenally. But where to get the cash?

Zoos used to be the foible of Indian Princes and, later, of European kings; though the first zoo on record, in China about 2000 B.C., was state-financed, called the Intelligence Park, and run for scientific study. The modern zoo, however, is rarely endowed, and it is only as the public interest increases that municipalities or states can vote larger budgets. Only a few, like those in New York or London, have been fortunate enough to receive important private grants.

But even without much money, imagination can still accomplish a lot in zoos. You may have noticed in the elephant run of some zoos a formidable rough-surfaced pillar—it's a back-scratcher! In at least one zoo you'll find another bit of thoughtfulness: running water in the raccoon's cage, because the raccoon habitually likes to wash every bit of its food in a running brook! Brushwood in the fox's cage costs little, but gives the fox the pleasure of brushing against it and so stimulating his coat

to a beautiful sheen. Sometimes an animal is given a pet; a fox terrier is often strangely comforting to an elephant. In the 500-acre country zoo of the London Zoological Society, the wolves have two two-acre paddocks of timberland, used alternately. In each of these paddocks is a big platform like a feeding table; it is there because the wolves like to dig under it for mating, just as they burrow when living in the wild.

The greatest single advance in zoos is the principle of viewing animals, not behind bars, but across moats. Fifty years ago, when Carl Hagenbeck first envisioned natural habitats for animals and opened his zoo, people gasped with fright as they saw lions emerging from rock caves and heading straight for them. But a 17-foot water ditch separated the lions from the public; and lions will not cross water. It is strange that America has been so slow to adopt this idea which has swept all over Europe. Only in our most modern zoos do you find 60-foot high monkey mountains; crags for the barbary sheep; and great sand paddocks for the elephant, separated from the public by a narrow ditch hedged by a low row of iron spikes which the elephant will not tread upon, thus demonstrating another phase of the elephant's caution.



At the zoo in Balboa Park, San Diego, California, where the animals enjoy a pseudo freedom in huge pits dug in the hillside, with no visible bars or cages

In such zoos, animals are actually more healthy than in the jungle. Lions bred in captivity are far superior to those running wild. Their size and coats are better because they get better food; their manes are more luxuriant because they're not torn by underbrush; and they live to a riper age in captivity. It is an odd fact that most animal lovers never think of old age in the jungle. But for wild beasts there is no graceful autumn of life; there is only a ghastly, inescapable disintegration or death dealt by more alert enemies. It is this senile loss of power—and usually only this—which drives a lion to man-killing. In freedom a lion rarely lives more than ten years. In captivity he lives to 25 and 30.

From the great museums of natural history, such as in New York, the modern zoos have borrowed the idea of having the three walls of the cage painted to represent the natural habitat—much more effective than just exhibiting animals in bare cages.

Zoo men are devoted to making their animals happy for their own sake and dramatic for your sake. They spend endless hours studying the latest dietary discoveries, such as, for example, a report that shrimps are preferable to cuttlebone in preserving the beautiful rose color of the flamingo. Or they may be up in the middle of the night to make sure the polar bear which had just had a cub—an anxious moment, as the cubs frequently die of pneumonia—was utilizing the straw put into its cage on the odd chance it would use it to keep the cub warm (and it did!). Or you catch them setting off on a journey half way around the world to settle some housing problem as to whether gorillas thrive outdoors during winter (as Philadelphia believes) or indoors (as London believes). Moreover, they constantly keep in touch with experiments in other zoos through correspondence, interchanging information that is frequently of mutual benefit.

In Munich, there are parrots on stands in front of the elephant pens. Their chattering, heightened by the tropical vegetation, gives a brilliant semblance of the jungle. In Leipzig, the polar bears have a diving board of green plate glass: with water slipping over it, it gives a wonderful illusion of ice. In a large zoo in London, the penguins are on different levels: now you're looking up at them; now you see them walking around a curve right next to you as they march in a stately trot down the ramp to their swimming pool. In Berlin, you see seals swimming not only on the surface, but there's a "lower level" where you see them under water. In Philadelphia, the beaver are given a full lake, wherein they can perform their miracles of building. Another idea which has proved very popular is to open the zoo on certain nights so visitors can see the vampire bats and other wild life that become active only during the night.

Labels are features often neglected by zoos: usually you find just *Panther, Felis Cericolor*, whereas, in Washington, for example, you learn interesting facts about the panther, such as that it is one of the most untameable of all animals, and so on.

A puzzling zoo problem is the peculiarly American habit of going to the zoo to torment the animals. In Washington, a taxi driver and his girl friend found some sort of release in letting dogs into a deer run: three fine animals were torn to pieces. In Philadelphia, stone-throwers killed several flamingos. In the few American zoos which have dared to have open-air snake pits, as is common in Europe, the results have been disastrous: brave young men jump into the pit and steal the snakes—for reasons best known to themselves.

What, the animal lover frequently asks when hearing of such isolated atrocities, is the point of keeping wild animals in captivity at all? Why spend millions of dollars to retain animals which may satisfy nothing more than curiosity? Fortunately, the average man values the zoo because it is the only glimpse of the jungle he will ever have. Beyond that, he gets from the zoo some realization of the world's past; some contact with nature; some humility that he seems to need and cling to in his present-day mechanized life.

# THE SEARCH FOR

## The Hunt for Stars that are Exceptionally Bright and For Those that are Exceptionally Faint is Not So Simple a Procedure as it at First Appears

By HENRY NORRIS RUSSELL, Ph. D.

Chairman of the Department of Astronomy and Director of the Observatory at Princeton University. Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington. President of the American Astronomical Society.

THERE is always a certain interest in exceptional objects—those that set a record or come near it. Sometimes the record-breakers are easy to pick out—like Saul standing head and shoulders above the Israelites—but they are not always obvious.

It has long been known that the stars differ enormously in brightness. Some are known to exceed the sun a thousand-fold in brightness, and others to give less than a thousandth of the sun's light: but if we seek for those still brighter or fainter, we get into trouble.

A star ten thousand times as bright as the sun should be easy to see. At 500 light-years' distance it would appear to be of the first magnitude—at 5000 light-years it would still be visible to the naked eye. Even if it were a million light-years away it would appear to be of magnitude 17.5—easily observable with great telescopes.

If such objects exist in our own galaxy, we should find them among the naked-eye stars. The trouble comes in picking them out.

It is not much use to try to do this by direct measures of parallax, for even a first-magnitude star of this real brightness would have a parallax of only 0″.006. Despite the remarkable accuracy of modern photographic measures, this is about at the limit of detection—it corresponds to 1/50,000 of an inch on the best plates. A good series of observations suffices to fix the number of hundredths of a second of arc in the parallax with some assurance; but to get the thousandths accurately is still beyond our skill. We know that certain stars—for example, Alpha Cygni and Canopus—must be very luminous—much more than 1000 times as bright as the sun—but we cannot say just how much brighter they are.

The only isolated stars for which we can do better are a few novae, the distances of which can be found by studying the expanding nebulae ejected from them during the catastrophe. The distance of Nova Aquilae was thus found to be 1200 light-years, and its maximum luminosity 300,000 times that of the sun—but it held this for less than a day.

Otherwise, our best hope is to find the distance of a cluster or cloud of stars, and then pick out the brightest objects in it. The richest hunting grounds are in the Magellanic Clouds—which are now regarded not as scattered fragments of the Milky Way, but as the nearest of the independent galaxies. The distances of these clouds are accurately determined from observations of the numerous Cepheid variables in them, but are so great, about 100,000 light-years in each case, that a star 10,000 times as bright as the sun would look to us fainter than the 12th magnitude.

Now, between us and the Magellanic Cloud there is an extensive foreground of much nearer stars. By counting the number of stars per square degree in the surrounding regions of the sky, we can estimate about how many such intruders appear on our photographs—but how can we pick them out individually? This would be practically hopeless were it not that the Cloud, as a whole, is receding rapidly from the sun. The radial velocities of a number of gaseous nebulae in the large Cloud agree closely with a mean of 275 kilometers a second. Practically none of the field stars in the foreground will be moving as fast as this. So, if we can measure the radial velocities of the stars by wholesale, we can pick out those that belong to the Cloud. Observations with slit-spectroscopes would be exceedingly laborious, but a better way is open: Photograph the region with a prism before the telescope, so that each star shows as a spectrum, and place in front of the plate a cell containing a thin layer of a solution of neodymium chloride. This solution absorbs light in narrow bands—one of which is almost as sharp as the wider stellar lines. Its position in the spectrum is, of course, fixed, while those of the stellar lines will be shifted by the Doppler effect.

MEASURES on these spectra give the radial velocity with a probable error of about 10 kilometers a second. For stars belonging to the Cloud, the shift would be large enough to be detected by inspection, without measurement.

To get 12th-magnitude stars with this device should be practicable, though not easy, and it should thus be possible to get a complete list of the brightest members of the Cloud and far more information about the stars of very high luminosity than is now available. A few stars with peculiar spectra, showing bright lines, certainly belong to the Cloud—since no similar objects are found outside it. The brightest of these exceed 100,000 times the sun's light.

The search for faint stars is quite different. To begin with, there is probably a natural limit of some sort to the brightness of a star; but there is obviously no limit to its faintness, since we know that bodies, like the planets, exist which give out no light at all. The question is really: "What are the faintest objects which we can see (or photograph) at stellar distances?"

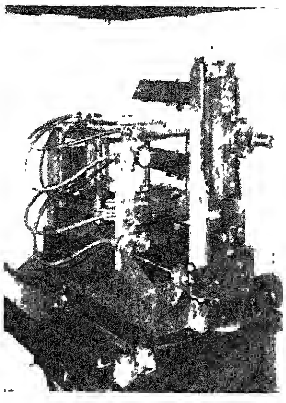
Here, evidently, we must look among the nearest stars. If we could make a complete list of these, the faintest among them would answer our question. So now we have to pick the nearest stars, among all apparent magnitudes. To do this by direct measures of parallax would be practically impossible, for there are millions of faint stars in the sky, and a good parallax determination demands accurate measures on a dozen plates or more. But it is possible to pick out the stars with considerable proper motions relative to their neighbors. If we have two plates, taken 20 years or so apart, and put them in a blink-microscope—such as was used to discover Pluto—the great mass of the faint stars will form a substantially unchanged background, against which the few stars with considerable motion will show obvious shifts. In this way a complete list of all the stars with motions faster than about 0″.2 per year may be made, and many slower motions detected when the plates are at their best. It is essential that the two plates should be taken with the same instrument, so that any small distortions of the images may be the same on both.

The earlier work of this sort was sporadic—on fields which happened to have been photographed years before, for one purpose or another. Various observers, notably the late Max Wolf at Heidelberg and Ross at the Yerkes, have discovered large numbers of proper-motion stars, some of them very interesting. A systematic and thorough survey has been

# EXCEPTIONAL STARS

made by Luyten—formerly of the Harvard Observatory and now at the University of Minnesota—using plates taken about 30 years ago at the Harvard Station at Arequipa, Peru, and duplicated recently at the new station at Bloemfontein, South Africa—to which the same telescope had been moved.

More than a thousand pairs of plates are available, covering the entire southern half of the celestial sphere (except for a few regions which were missed at the earlier epoch) and showing stars to the 17th or 18th magnitudes. Dr. Luyten has "blinked" these (examining the images of about 25,000,000 stars!) and has found more than 80,000 stars with perceptible motion. It will be years yet before all these motions can be measured and worked up. Meanwhile, one important result has appeared. Among all these stars, not one has a motion exceeding 4″ per year, and no star fainter than the 17th magnitude has a motion as great as 1″ annually. This means that our lists of stars of really large proper motion must be nearly complete, and will be almost entirely so when a similar survey can be made for the northern half of the sky.



A blink-microscope, an instrument mentioned in the text. Eyepiece at the right, connected by prisms with two round arms extending to left, each terminated by a right-angled prism and each having below it in its field of view one of the two nearly identical plates being compared in order to ascertain whether slight changes of position of any star have occurred. In the more common type, alternate views of the plates are had by mechanically moving an element from one to the other, but this particular comparator is one invented and constructed (optical parts by Fecker) by Prof. Heber D. Curtis, astronomer at the University of Michigan; it employs lamps to illuminate the plates, and blinks first one and then the other plate by means of a motor which controls the lamp circuits. Speeds from one blink every two seconds to four blinks a second are employed

By and large, the stars of large proper motion are the nearer stars. Now and then we get a star at a considerable distance, with very rapid actual motion; but these great space velocities are rare. Moreover, the proper motion list leaves out relatively few of the nearer stars. A star whose proper motion is less than twice its parallax must be moving at a speed less than 9 kilometers a second at right angles to the line joining it to the sun. As the average motion of a star in space, relative to the sun, is fully 30 kilometers a second, it is evident this can happen only when the star's motion is directed nearly toward the sun or away from it—which will happen in but a small percentage of cases.

The larger the proper motion, the nearer, on the average, the star will be —and, of course, the faster will be its actual "cross-motion." A recent study by van Maanen, using parallaxes of 651 stars of large proper motion, shows that for a tenfold increase in proper motion the average parallax increases by a factor of 6.6, leaving only a factor of 1.5 to represent the increase in real speed.

For stars of the same proper motion the average parallax changes very little with the apparent brightness. To decrease this by five magnitudes, or to 1/100 of the original value, diminishes the mean parallax to 78 percent of what it was before, showing that the second group of stars really averages only 1/60 as bright as the first.

The proper-motion surveys are therefore a very efficient method of picking out the nearer stars. Using these results, van Maanen concludes that within a distance of 13 light-years from the sun (corresponding to the large parallax 0″.251) there are 55 stars (of which 22 are already known). In the shell between 13 and 20.6 light-years' distance, he calculates that there should be 164 stars (of which 34 have so far been observed for parallax). This shell has three times the volume of the inner sphere, so that the estimated numbers of stars (which were derived independently) are in good agreement. It is evident that there is plenty still to do for the parallax observers—though only a few great telescopes can tackle the very faint stars which remain to be studied in the future.

Of these stars near the sun, van Maanen calculates that one quarter are brighter than the absolute magnitude 10.2 (1/140 of the sun's light). Another quarter are more than 1/1100 as bright as the sun; the third quarter exceed 1/7500, while about three percent of the whole give less than 1/100,000 of the sun's light.

The rapid falling off in the numbers of very faint stars is surprising. It should be remembered that these faint stars are very red (except for occasional white dwarfs) and of low temperature. With falling temperature the ratio of the visible light radiation to the infra-red radiant heat drops very rapidly, and it is probable that, if we could measure the temperatures of these very faint stars, and calculate their heat radiation, we might obtain results which looked very different.

The faintest star so far known is Wolf 359 (its number in Wolf's proper-motion list). This has a proper motion of 4″.84 and a parallax of 0″.413, according to van Maanen. Its photographic magnitude is 15.4, but since it is very red (spectrum $M_4$) it may be as bright as 13.5 visually. This would make its absolute magnitude 16.6, and its light 1/35000 of the sun's.

We can hardly guess at its size, for the amount of light given out per square mile varies very rapidly with the temperature. At 3000 degrees it is about 1/50 as great as for the sun; at 2500 degrees 1/200, at 2000 degrees 1/2000 (making allowance for the fact that most of the light is red). With a temperature of 2000 degrees the diameter comes out less than one fourth of the sun's; with 2500 degrees, about that of Saturn. It looks as if this might be a small, dense body, part way on the road which ends in the white dwarfs. If the star's brightness could be measured in the infra-red, we might be able to say more.

Another very faint star has recently been announced by Luyten. It was discovered during his proper-motion survey, is of photographic magnitude 14.3, and has a proper motion of 3″.27 per year. Measures on six plates taken at the Harvard Station at Oak Ridge indicate a parallax of 0″.53. The probable error ±0″.13 is large, so that it cannot yet be certain whether this star is nearer than all but two others, but it is evidently among the nearest and faintest objects known.—*Princeton, New Jersey, March 5, 1937.*

# Air Transport Looks Aloft

## Flight in the Stratosphere Offers Many Advantages . . . Experimental Flights being Carried Out Systematically . . . Huge New Planes Designed

By REGINALD M. CLEVELAND

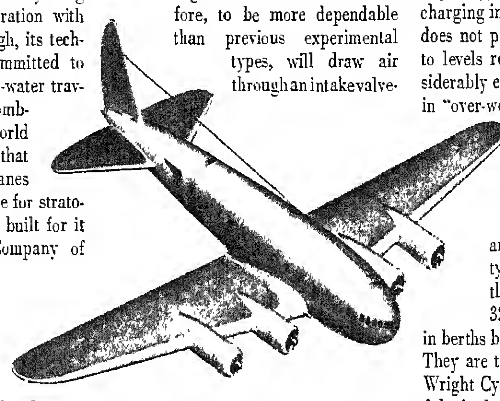
WITH almost startling suddenness, speculation as to when and how sealed, supercharged cabins would be used to transport air passengers at levels above the normal storm area has been translated into orders for airplanes provided with fuselages suitable for such supercharging. It is plainly evident that air transport, through some of its most responsible and dependable channels, is going "up stairs," at least in an experimental way. This raises many questions of interest as to operating efficiency and passenger comfort.

Pan American Airways, which, from the laying out of its immensely long over-water routes in co-operation with Colonel Charles A. Lindbergh, its technical adviser, has been committed to water-going aircraft for over-water travel, threw something of a bombshell into the aeronautical world recently by announcing that four-engine, land monoplanes with pressure cabins, suitable for stratospheric operation, would be built for it by the Boeing Aircraft Company of Seattle. Before the New York alumni of the Massachusetts Institute of Technology, Juan T. Trippe, President of the international airline system, revealed a number of details as to these revolutionary aircraft which have been under development for many months by engineers of the manufacturer and of the operator, working together.

They are to be 42,000-pound airplanes with cylindrical, wholly streamlined fuselages, powered with specially supercharged engines developing a total of about 5000 horsepower. Although Mr. Trippe did not specifically say that they would be used in transatlantic service, he did say that, as mail and express planes, they would have a range of 4000 miles and would be able to cross the Atlantic in 10 hours.

THIS range is more than ample for the Great Circle course between Newfoundland and Ireland, which will be one of the routes operated jointly by Pan American and Imperial Airways, and it is, perhaps, significant that the great new airport development at Botwood, Newfoundland, some 40 miles northeast of St. Johns, includes a land airport with a main runway a mile long and 1200 feet wide.

For night service, the pressure cabin Boeings are to have accommodations for 18 passengers in commodious berths and 8 more in comfortable sleeping chairs. By day they will accommodate 32 passengers in lounge seats. A new type of supercharger for the cabin, mechanical throughout and believed, therefore, to be more dependable than previous experimental types, will draw air through an intake valve well cut along the wing. The air will be pumped inside the wing, through a miniature air-conditioning plant at the inboard engine, and from there into the sealed cabin where ducts will distribute it uniformly from the control compartment through the passenger compartments and thence into an anti-pressure chamber aft where the exhaust valves are located. These superchargers are said to require only a small fraction of the power of one engine and a complete set of dual mechanisms will be built into each plane.



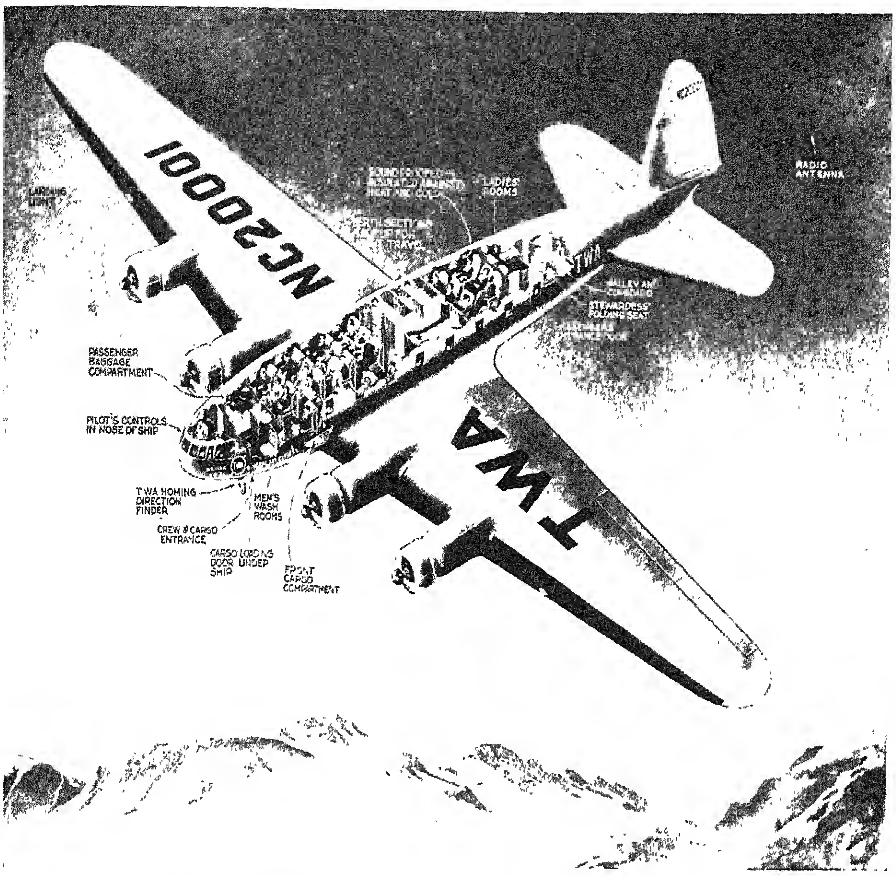
How the Pan American Airways stratosphere plane will look when in flight. The details are given in text

The cabins are designed to withstand an internal pressure of six pounds to the square inch above that of the surrounding atmosphere. This is expected to provide, at 20,000 to 25,000 feet, cabin conditions now usual at flight levels of 8000 to 12,000 feet. Without additional engine supercharging, the planes are expected to be able to operate up to an altitude of 36,000 feet and to have cruising speeds at the high levels of better than 260 miles an hour, using only half the available engine horsepower.

Just prior to the announcement of these planes, Transcontinental and Western Air revealed that it had signed a contract with the Boeing Company for six quite similar airplanes of the four-engine type, also designed to take supercharging in the cabins, although the line does not propose to use pressure or go to levels requiring it until after a considerably extended period of experiment in "over-weather" flying which is being pushed continuously for it by Lt. Commander D. W. Tomlinson, assistant to President Jack Frye.

The airplanes ordered—and an option for 17 more of the type has been announced by the company—are also to carry 32 passengers by day and 18 in berths by night, with four in the crew. They are to be powered with the G-100 Wright Cyclone engine, the most powerful single-row radial yet put in production, which has a rating of 1220 horsepower for emergency and 1000 horsepower for cruising.

THESE Boeings for TWA are of a type known as No. 307. This is the basic design upon which the 307-S, the stratospheric plane for Pan American, has been projected. As one result of upper air research, Boeing developed means by which the standard 307 could be stressed for pressure. That is to say, this plane can be converted into a pressure cabin type with the addition of some 400 pounds of structural changes. Pan American requires 500 hours of pre-service testing for any new type of airplane which it purchases. After these tests have been made, the results can be made available to any purchaser. The first two of the 307 class to be delivered will be the stratosphere jobs and then the six standard planes. By that time it is expected the 500-hour tests will have been made and, at TWA's option, the rest of their craft of the type may be stratospheric jobs. It is also understood that the Royal Dutch Airlines (K.L.M.) plans to order similar craft.




Scale drawing of the high-altitude plane being built for Transcontinental and Western Air, Inc.

The "over weather" work which Commander Tomlinson has been doing with a specially equipped Northrop Gamma laboratory plane has provided him with more actual experience of conditions at 30,000 feet and above than any other living man. He has discovered by practical experience what the scientists hold, namely, that there is no definite level which is fixed at all times and at all places where the stratosphere begins. The air gets colder the higher you go, until a certain height is reached. After that no matter how high you go it remains constant at about 70 degrees below zero, Fahrenheit, and that "certain" height varies from about 25,000 feet to 48,000 feet.

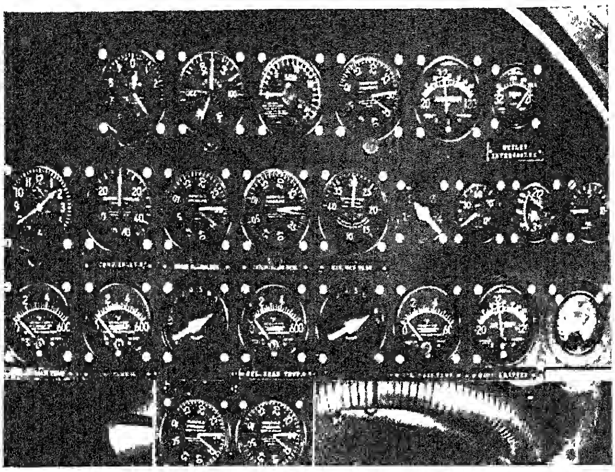
Not long ago Tomlinson made a 7½ hour flight during which he was unable to get over cloud formations even at the ceiling of his airplane, which was 36,000 feet. Normally, however, conditions from 20,000 to 25,000 feet provide clear vision "over the top" and smooth, bumpless air free from turbulence.

Tomlinson also found, almost to his cost, the dread potential effects of oxygen deficiency. With his beam radio out and his two-way voice radio very noisy from static, he flew his ship with the stick between his knees and alternately talked into his transmitting mouthpiece and took a whiff of oxygen from a tube. Once he became so absorbed in the radio conversation that he neglected to take a whiff for something more than 15 seconds. He almost passed out and had to breathe the raw oxygen for several minutes before his senses cleared.

INTENSIVE studies of the effect of oxygen deficiency have been made of late by another of the great transport systems, United Air Lines. Taking a doctor aloft and a number of volunteers to act as "guinea pigs," the effects of too little oxygen were observed at various levels from 14,000 to 22,000 feet by giving the human "guinea pigs" simple problems in arithmetic and simple manual tasks to do. Without additional oxygen, their writing was scrawly, their answers to simple problems incorrect and their motion reactions slow and blurred. With oxygen, they promptly returned to normal functioning, both mental and physical.

A broad field, only touched upon thus far, remains for exploration as to the physiological effects of altitude, quite aside from the question of oxygen deficiency. Dr. Emanuel Esrati, who has spent a number of years in research on pilot reaction at various levels above the 8000 or 10,000 feet that might be considered normal, both in Palestine and in Germany for Lufthansa, holds that temporary desiccation of some of the human organs is a common effect upon certain individuals when they reach abnormal altitudes. Such drying of the gall bladder, he finds, produces immediate symptoms of melancholia. Should wider and more intensive experiment bear out the general application of this and similar theories, it can be readily understood that problems will surround high-altitude flight—both as to pilots and as to passengers—more complicated than mere matters of pressure and oxygen supply.

There are also aircraft engineers of established reputation who hold that, except for extremely long ranges, the technical difficulties of stratosphere operation, admittedly both many and great, outweigh the advantages. For use in the continental United States, for example, a stratosphere airplane in transport service entails, they consider, compromises which, although certainly not insurmountable, raise technical and economic problems which are discouraging. Such an airplane must be able not merely to fly at 40,000 feet efficiently with the



"Candid" photographs are taken at short intervals of the instrument board of an experimental stratosphere plane, relieving the test pilot of a recording chore

special aerodynamic, engine, and propeller characteristics there demanded, but must be able to fly efficiently in the lower levels of the climb and descent and probably also of the westward trip.

This is not a "one way" country, insofar as stratospheric conditions are known at present. Commander Tomlinson has encountered winds of considerably more than 100 miles an hour velocity from the north and northwest at from 30,000 to 35,000 feet. It is believed that at 40,000 to 45,000 feet there is an almost constant westerly wind, averaging from 60 to 70 miles an hour. This would be a splendid advantage on the trip from California to New York, but how about the return journey? The theory is widely held, although by no means is the fact as yet established, that at 50,000 to 55,000 feet there is comparatively still air. So the transcontinental stratosphere airplane must move towards the setting sun either at this enormous altitude or well below stratospheric levels.

MUCH will doubtless be learned about these conditions from a wider use of the radio meteorograph, a device in which the Weather Bureau places much hope. This consists of a simple radio transmitting set carried aloft to very high altitudes by an ordinary sounding balloon. Its advantage lies in the fact that it can continue to send its radio signals of temperature, humidity, and wind conditions even though it go out of sight of a theodolite or be entirely lost. Dr. Karl O. Lange, of the Bluehill Observatory of Harvard University, has recently installed a high-altitude observation apparatus at the new gliding site of the Soaring Society of America at Harriss Hill near Elmira, and from its recorded observations much further light on upper air conditions is expected this year.

Some of the difficulties which confront the designer of high-altitude commercial aircraft have been the subject of a study by Michael E. Gluhareff, chief engineer of the Sikorsky Aircraft Corporation, who has presented a paper on the subject before the Institute of the Aeronautical Sciences. Mr. Gluhareff, who, with Mr. Sikorsky, has shown in the Clipper and super-Clipper designs, and in the plans for far larger flying boats, that he is not afraid of unexplored fields, finds these difficulties no minor ones.

Among them he notes the cooling of the engines and the oil, as it appears that cooling depends on the density of the cooling medium, and not on its velocity; that ordinary fuels would probably boil in the tanks if there were not sufficient pressure; that insulation of the electrical system would have to vary from that used at present, due also to low pressure, while batteries would have to be used instead of magnetoes; that propellers would have to be especially designed, as tip speed velocities increase with altitude, and that possibly propellers of four or more blades would be needed, or propellers of variable diameter, or several gear ratios on the engine.

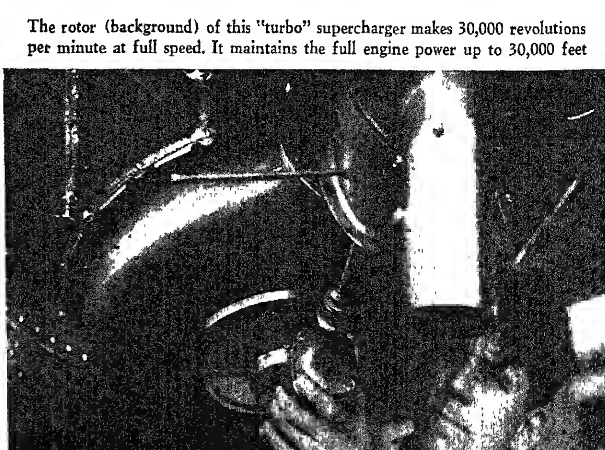
When it comes to passenger comfort and safety, he holds that the cabin must be supercharged, preferably to sea-level condition; that oxygen equipment can only be used to about 20,000 feet unless sufficient pressure is present in the cabin, and that when it comes to oxygen spraying, it would be necessary to deliver 5200 cubic feet of oxygen for 20 passengers during a period of 10 hours, and that equipment for this would weigh in the vicinity of 2500 pounds.

UNDER structural problems, Mr. Gluhareff, who has made a study of six hypothetical airplanes for the stratosphere, finds that in a cabin measuring 11 feet by 37½ feet an additional weight of 250 pounds would be required if the cabin were supercharged from 10,000 feet to 25,000 feet altitude. For 40,000 feet altitude, the additional weight would be about twice this figure.

The doors, windows, and hatches would have to be very strong and small. For example, he holds that at 40,000 feet altitude a small door, five feet by two feet, would have to withstand a constant negative pressure of 17,200 pounds. This means heavy locks and hinges also and, for the pilot's cockpit, probably a double windshield. Controls would have to be electrically or hydraulically transmitted to the surfaces, as direct controls would entail leakage.

It is plain, however, that the high levels so gallantly and significantly pioneered by the late Wiley Post when he flew the 190-mile an hour Winnie Mae about 270 miles an hour between Los Angeles and Cleveland by supercharging its Wasp engine and sealing himself into a pressure suit and helmet, are to be thoroughly explored and levels of 20,000 feet flown much sooner than had been expected.

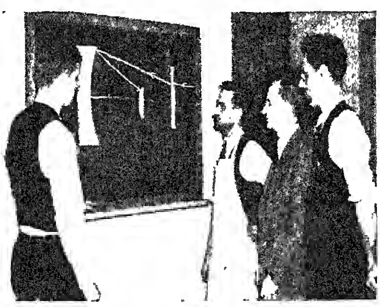
The rotor (background) of this "turbo" supercharger makes 30,000 revolutions per minute at full speed. It maintains the full engine power up to 30,000 feet



# Amateur Astronomers Active in Philadelphia

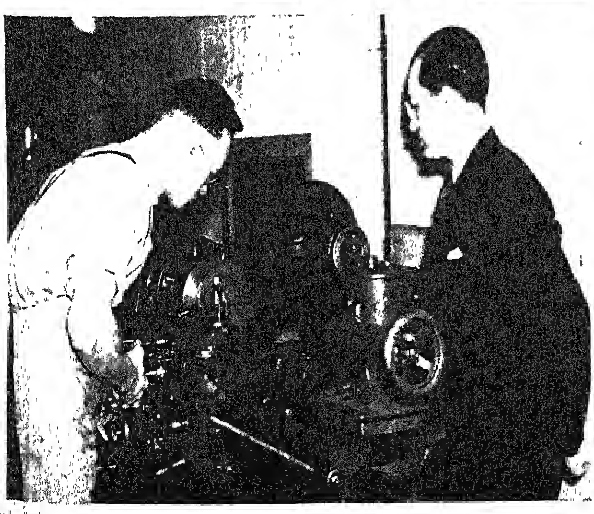
Clubs of amateur telescope makers and astronomers are now flourishing in at least 40 cities in the nation. and three of these clubs have shops actually within the local planetarium buildings. The Chicago Amateur Astronomers, formerly the Amateur Telescope Makers of Chicago, are housed in basement rooms in the Adler Planetarium in that city. The Optical Division of the Amateur Astronomers' Association, formerly the Amateur Telescope Makers of New York, similarly have shops in the basement of the Hayden Planetarium at the American Museum of Natural History in New York. and now the Amateur Telescope Makers' Section of the Franklin Institute meets and perspires over raw disks of glass in a shop above the dome of the Fels Planetarium of the Franklin Institute in Philadelphia. We show several photographs of activities in these shops.

A typical Thursday night session. The photograph shows half of the available pedestals around which the concave glass mirror disks of reflecting telescopes are ground and polished by hand, using the fine abrasives shown in the bottles and shakers on the shelves



*Right:* Telescope making leads to "all-night" arguments about optical theory, hence a small blackboard is conveniently ready for those who like to think

*Above:* Dr. Rodrich Boehmke (left), a Philadelphia optical manufacturer who has assisted the club with advice, and a machine on which telescope mirrors may also be made if the worker so desires



*Below:* A member of the club doing the heavy looking on while another member faces a tool used on the grinding machine preferred by certain workers

While thousands of amateur telescope makers work alone, either by preference or the circumstances of their isolation, the gregarious instinct leads many more to flock together, thus adding sociability to science. If two heads are better than one, three heads may be better than two, and 30 perhaps better than three. Half of the zest in constructing anything is contained in the knowledge that other hobbyists of the same kind are working alongside, but it is also true that optical work of the finest grade has been done by many entirely isolated amateurs. Seldom, however, does this last long, for friends soon become inoculated by the "bug."

# HIGHWAY FREIGHTERS

## A Half-Billion Dollar Industry . . . Furnishes Flexible Transportation for a Wide Variety of Products . . . Sturdy Pneumatic Tires a Vital Factor

By PHILIP H. SMITH

MOTOR truck manufacture is a half-billion dollar industry. Add to this wholesale value of product the value of business done by companies and individuals engaged in truck transportation and you get a major industry centered around a product a little more than 30 years old.

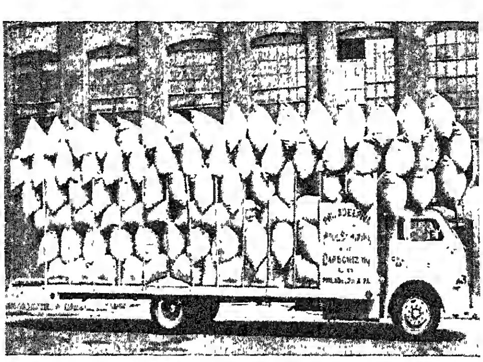
Today the motor truck moves 2 percent of the ton-miles and 5.5 percent of the nation's carload tonnage. If these percentages seem small it is only because the total movement of merchandise is so enormous. In actual figures the ton-miles for trucks are 2,164,000,000 and the carload tonnage 16,145,000.

To trace the development of this giant, one need go back no more than 15 years. Truck production had already reached a high figure 15 years ago, but the balloon tire made its appearance in the early 'twenties and that was the real beginning of the high speed transportation of heavy loads. Long distance, interstate trucking which captures the imagination could hardly have become feasible had the pneumatic tire not been perfected to take cruel punishment.

The human factor in truck transportation was also affected by balloon tires. Many can recall the stories about the short driving-life of truck drivers because of the incessant jar as the solid-tired vehicles pounded over the pavements. It is fact that driving was a gruelling occupation, fit only for young men and for limited periods. The balloon tire banished that difficulty, and it did something else. As a result of the cushioned ride, it was no longer necessary to use magneto ignition, acetylene gas for headlights, and hand cranks for starting the engine. Storage batteries, unable to take the punishment inflicted by riding on solid tires, became feasible and thereby provided adequate and safe lighting, while self-starters gave driver relief.

The advent of the pneumatic for heavy trucks may seem a small matter, but its significance can hardly be overemphasized. Speed is a vital element in truck transportation and to the extent that heavy loads can be moved quickly, by so much does trucking become competitively desirable.

A second development of great import was the switch from four- to six-cylinder engines. This is a highly controversial statement with which many authorities will disagree. However, high speed became practical when power was increased without a corresponding increase in engine weight, made possible by the lightening of reciprocating parts and stepping up of engine revolutions. This development of motor-truck engines is akin to advances made in passenger-car engine design.



With its engine placed under the driver's cab, this 215-inch *wheelbase, stake-body motor truck carries 107 bags of wool*

Within the period of 15 years have come advances in metallurgy which, applied to truck engineering, give a chassis capable of carrying heavy loads at high speeds. If it were not for the knowledge of alloying metals to increase strength of steels, the present-day motor truck would be a very cumbersome vehicle, toting around a deal of excess weight. Almost every part of a truck instances the use of metallurgical advances. Consider, for example, the size and weight of axles and axle housings, in relation to the stress and strains they must undergo.

Given an excellent vehicle as the product of engineering research of a most painstaking variety, what improvements are likely to be forthcoming? Is the motor truck on the eve of any radical change?

The objective of engineering work is toward achieving greater economies in operation and maintenance. Every step toward this objective gives greater justification for truck use. Motor-truck transportation is competitive, and competition forces these economies. Then there is the added incentive given by hampering legislation and taxation. All-over design and motive force are the two points at which the problem is being attacked.

ALTHOUGH the science of metals has accomplished wonders with the modern truck, continual research aims to find ways and means for lightening vehicles without impairing their load-carrying capacity. The objective might be described as an attempt to make the vehicle weight smaller in proportion to the total loaded weight, which is tantamount to increasing payloads, given any specific vehicle dimension. It would occasion no surprise if, very shortly, we found trucks being built without frames, the body serving as the structural member.

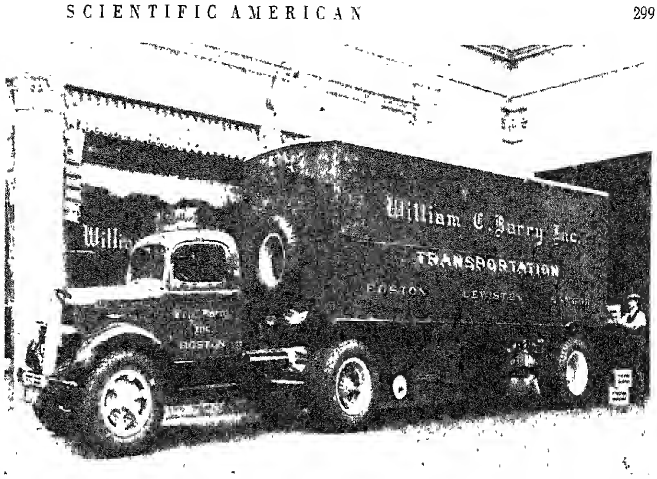
There has been a great deal of experimental work and corresponding progress in the development of lighter weight bodies. Aluminum is coming into wider use, while high-strength, lightweight steels are entering into body construction as never before. If a ton can be cut from the weight of a vehicle in this manner, an extra ton of merchandise can be carried without increasing the power or the over-all weight of the vehicle and the economies are obvious. Savings of this sort are now common and in the long run they outweigh the higher initial cost of the equipment.

There are engineers who believe that economies in motive power will be brought about by adoption of the Diesel engine. This is still a moot question. Steady progress has been made in rendering the Diesel suitable for trucks and about 2500 vehicles so powered are

in commercial operation, demonstrating surprising fuel economy. On the Pacific Coast, for example, where Diesels are most widely used, there are several companies operating large fleets and finding them quite satisfactory. On the average, fuel consumption is only about 50 percent that of the orthodox gasoline engine.

There is no possibility that Diesels will capture the truck overnight. As now constituted, the Diesel engine is more costly and requires more frequent overhauling than the gasoline engine. These obstacles must be overcome before the advantages stack heavily in its favor. Furthermore, there is not the great differential saving in fuel that is commonly supposed. Less fuel is burned and the fuel is of a cheaper grade, but that's only part of the story. All but 13 states have imposed a tax on Diesel fuel and this is usually as high as the gasoline tax. There is even talk of higher fees for Diesel-powered trucks, which would reduce the possible savings. Another fact, not widely appreciated, is that improvement in the Diesel has been an accompaniment, if not the result, of improvement in the fuel. Diesels do not burn fuel just as it comes from the well. Today's fuel as used in the truck is a refined product. In a sense, therefore, the Diesel and the gasoline engine have been moving nearer together and there are many capable engineers who believe that the Diesel's major contribution may be the spurring of research to make the gasoline engine more efficient.

It would be extremely unwise to state that the Diesel is not the coming motive power for trucks. Posing the drawbacks is simply one way of indicating that progress will be slow and the outcome uncertain. In view of what has been accomplished in taking a cumbersome, stationary engine and adapting it to a moving vehicle, there is reason to believe that equally great advances can still be made, but relative costs will be the deciding factor in ultimate usefulness.




Tractor-trailer combinations, such as the long-distance trucking unit shown above, have had a tremendous influence on highway transportation. With such combinations, the tractor units may be kept in active service while the trailer units are being loaded or unloaded

Outside the field of transportation there is little appreciation of the immense influence that legislation has had both in design of trucks and the growth of trucking. All authorities will say that legislation has retarded the use of motor trucks, either by the imposition of penalizing taxes, or the promulgation of weight and dimensional rulings. This has made for added difficulties, but trucks and trucking have forged ahead in spite of it.

The purpose of legislation is manifold. It is prompted by a desire to make trucks pay for the cost of highways; to prevent them from injuring the paved surfaces; to get revenue which cannot be derived as easily from other sources; and finally, to force the shipment of merchandise back to the railroads. A discussion of the merit or demerit of such legislation does not fall within the scope of this article, but we need to tell the effects upon design and growth.

Into the woods goes the motor truck to haul out loads of logs, economically as well as speedily

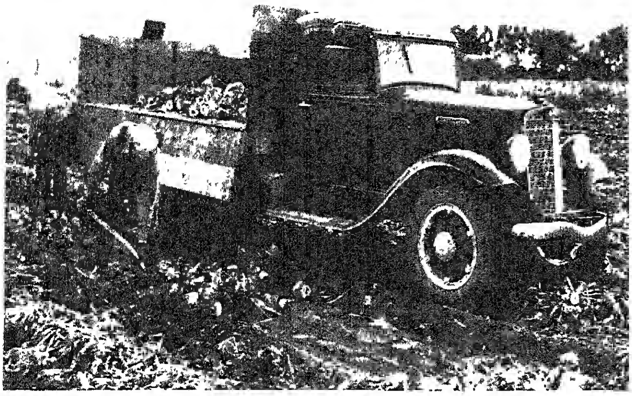
Privately operated trucks pay about $2\frac{1}{2}$ times as high a tax as passenger cars; common carrier motor trucks pay six times the car rate. The grand total of 354,000,000 dollars to which the annual tax on trucks has soared comprises registration fees, gasoline, state and municipal taxes, as well as any special local taxes. In certain states, the purchaser of a pneumatic tired, three-ton truck, must pay close to 1000 dollars in taxes before he can begin to operate. This means that motor vehicles which compete as common carriers must be able to earn high fixed charges as well as pay their way before they can be regarded as money-making investments. That they succeed is evidenced by the sustained growth of truck transportation.

Length, height, width, and load restrictions also impose a burden, the greater because these restrictions are not uniform throughout the 48 states. Where the most rigid rulings prevail, bottle-necks are created which mean virtually that interstate haulers must comply with these minimums and lower the efficiency of operation for the entire run.

TRUCK design reflects state legislation because limitations have spurred manufacturers to devise ways and means of surmounting them. Curtailment of length, for example, has given rise to placing of the engine under the driver's seat; thus more space is made available for the load. Weight limitations have forced attention to spreading the weight over a larger pavement area, as accomplished by multi-wheels. Lightening the weight of bodies also exemplifies this effort to make transportation efficient in the face of laws which were not drawn up with payloads in mind.

Payload is the factor of motor-truck transportation upon which all eyes focus, irrespective of the type of service to be performed; that is, whether it is private, intrastate, or interstate hauling. Payload is the talking point in design and operation because economy, rather than gadgets or beauty of line, is what sells and keeps trucks running.

Legislation is going to continue to



On the farm the motor truck has many and varied applications, from harvesting certain crops to transporting produce at high speeds from the farm to market

have influence over trucking, but its power may be more beneficial than heretofore from the industry's standpoint. Greater uniformity of laws is coming about as the result of persistent labor on the part of national associations, safety groups, and other interested parties. Of much greater significance is the Federal Motor Carrier Act of 1935 which is being administered by the Interstate Commerce Commission. This Act puts common and contract motor-carrier transportation under a co-ordinated control.

The possibilities for good which are within this Act can hardly be understood without reference to the motor-truck transport industry as it has grown and is today. One of the major complaints of soundly operated companies has been that any individual could engage in the enterprise by the mere purchase of a truck and without due provision for amortization, safety, decent hours or wages for drivers, or any of the many requisites which are the mark of good business. The ranks of trucking have been filled with small operators who thus came into being and then disappeared through bankruptcy, but not before they had undercut rates and seriously demoralized the business.

MOTOR-truck transportation is still primarily a business of small operators, although concentration in fewer hands is proceeding rapidly. It is a business in which the vast majority gain little more than a livelihood and the minority get the volume and make the money. The most recent Government census, which covers the year 1935, bears this out in figures which show 1.5 percent of operators getting nearly half the total revenue, while on an income basis 81 percent earned less than 5000 dollars for their year's work. This census also relates that local operators received 38.4 percent of revenue, interstate concerns 36.9 percent, and intrastate 24.7 percent.

Transportation officials believe that this picture is about to undergo a rapid change because the Carrier Act specifies safety equipment, qualification of drivers, and publication of rate schedules. Once rates are set, they cannot be shaded. The outcome, officials believe, will be the elimination of the fly-by-night, or marginal, operator who lacks necessary capital. For the first time in its history, therefore, motor-truck transportation becomes a legitimate, well-recognized industry—a respectable part of our national transportation system. While some individuals may be heavily penalized, the I.C.C. regulations should help to put operations on a sounder basis.

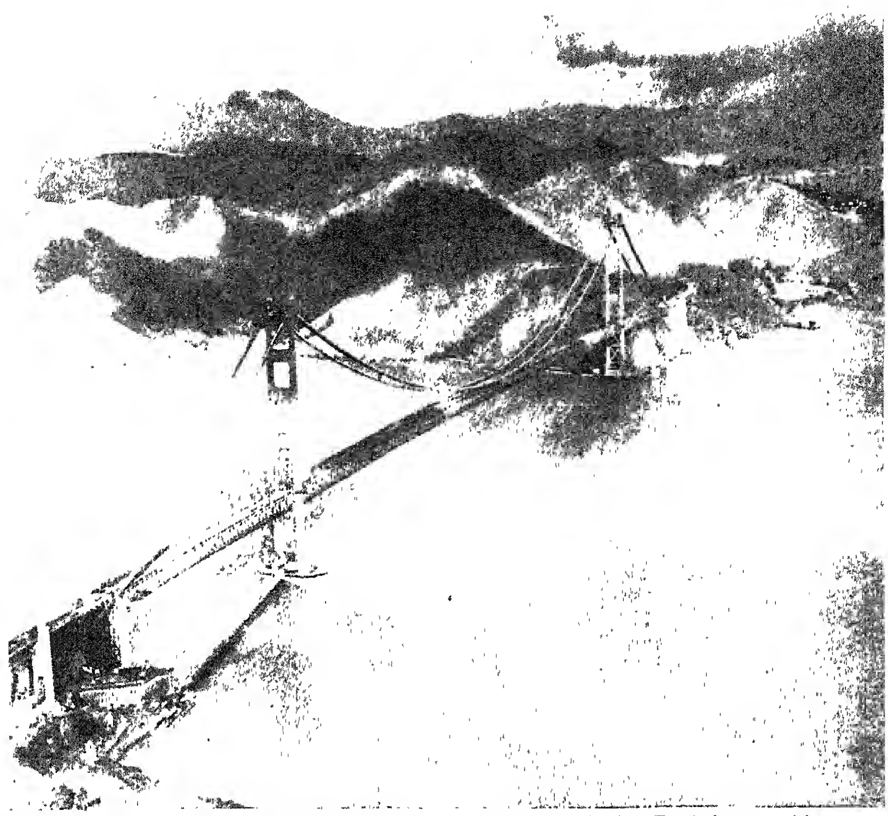
There are over 4,000,000 motor trucks in use in this country and millions of dollars in capital are employed. The drivers constitute an army of some 3,000,000, and the service rendered extends into nearly 50,000 communities where no other form of transportation is available. Growth to this stupendous proportion means that truck transportation is something more than an upstart or the gad-fly of the railroads.

Motor-truck production follows very closely the trend of general business and future expansion promises to tie with prosperity. Specialized equipment constantly broadens the market so that new industries can use the truck to advantage. Refrigerated trucks exemplify this. With the practical employment of dry-ice as a refrigerant, it has become more feasible to ship perishables; and the growth of such shipments is steady. The motor truck is now the predominant carrier of such commodities as milk, fruit, and vegetables, and comes very close to being the leader in transport of live stock.

There is no mystery about the development of the motor truck, nor its use as a vehicle of transportation. It came about because flexible transportation was a need and no other agency could supply it as well. Economy, speed, door-to-door delivery, shipping facilities when and as needed—all this is provided by the motor truck and modern living depends upon it. With intelligent regulation, with greater stability, and with the continued betterment of design in the vehicles themselves, trucks and trucking have a long way to go.

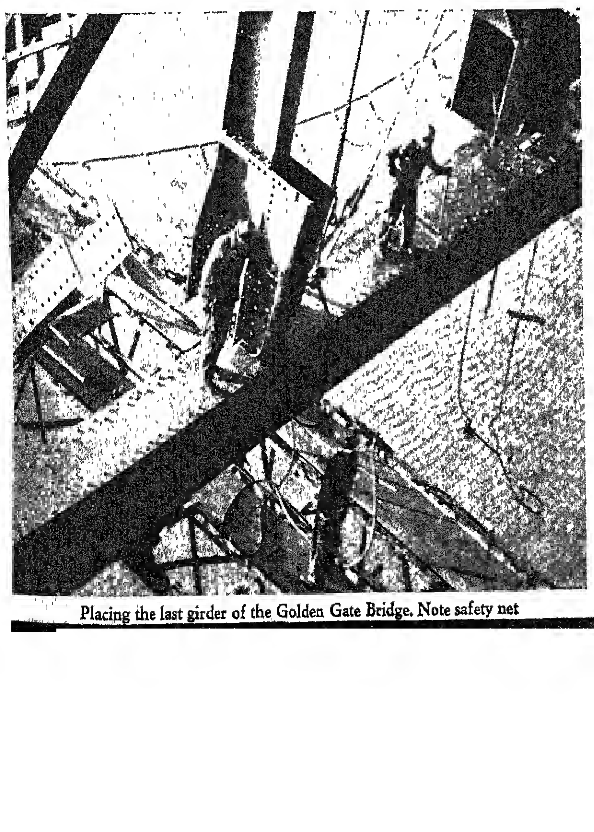
Photographs courtesy Autocar Company, International Harvester Company, and White Motor Company.


Coal loaded on trucks at the mine may be delivered directly to the distributor with a minimum loss of time and with no costly trans-shipping to cut into profits



Recent air view of the Golden Gate Bridge, with Marin hills in the background and Mt. Tamalpais at upper left

# How Big is a Bridge?



Placing the last girder of the Golden Gate Bridge. Note safety net

UPON the question in the title of this page depends the answer whether the Golden Gate Bridge at San Francisco, to be completed in early May, will assume first place among the world's suspension bridges, or whether the George Washington Bridge at New York will retain this distinction. Determination of "bigness" in bridges depends largely upon what measuring stick is used. Considering length of span, the Golden Gate Bridge, with a 4200-foot main span, is the world's longest suspension-type bridge. The George Washington Bridge, however, is designed to carry a heavier load, although its main span is 700 feet shorter and its cable length 2482 feet shorter than the western structure. On the other hand, diameter of the two cables supporting the Golden Gate Bridge is 36½ inches as against 36 inches for the George Washington structure, which has four cables providing a total supporting strength of 350,000 tons, as against 193,004 tons for the Golden Gate Bridge.

# PARIS PREPARES FOR GAS

## Gas Masks for Civilians . . . Gas-Proof Shelters and Cellars . . . Emergency Squads Equipped With Gas-Proof Clothing and Steel Helmets

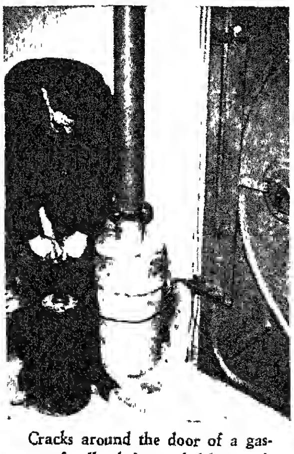
THE cry "*Aux abris*" ("To the gas shelter"), together with the screeching of sirens, galvanizes the civilians of present-day Paris into instant action. Wrought up to a point verging on hysteria by unceasing threats of war in Europe, French authorities are taking steps to protect the population of the country from gas attacks by an enemy. A vital part of these preparatory measures is the intensive education of civilians in the proper methods of saving themselves from the disastrous effects of poison gas. Regardless of what may be said about the use of such gas in any future warfare, it cannot be denied that it has a great psychological effect on non-combatants and that the morale of a whole country can be vastly strengthened by education conducted along proper lines.

The work being done in Paris today is typical of the precautions being taken throughout France. Approved types of gas masks can be purchased for approximately three and a half dollars and are available in drug and department stores, as well as in every police station. If the purchaser is inclined to be fastidious he can have a special mask made to order for about 20 dollars. Training schools have been established throughout the city to instruct civilians in the proper method of donning a gas mask and in other precautions that must be taken in case of a gas attack.

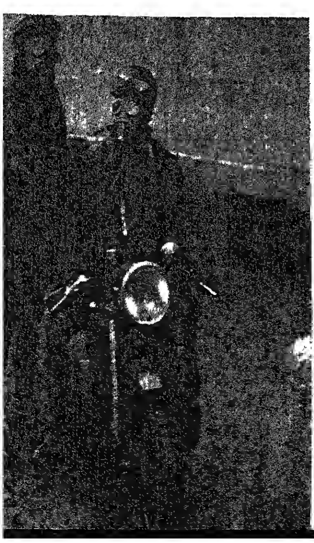
But gas masks are not the only means of protection being developed in Paris. Experiments are being carried on with small concrete gas-proof shelters, housing three persons and provided with a cone-shaped top which is said to be capable of diverting shells and thereby rendering the structure less liable to damage. Another type of gas shelter being developed consists of a double-walled collapsible tent, equipped with an entrance that can be made completely gas-tight. These tents have no supports other than air; when one is to be used, compressed air from a motor-driven blower is forced into the space between the double walls, thereby inflating the tent like a balloon and providing a

In a school recently organized in Paris, professional nurses teach civilians the proper use of newly developed gas masks

*Right:* Members of a first-aid team, clad in gas-proof uniforms, being disinfected after entering a gas shelter

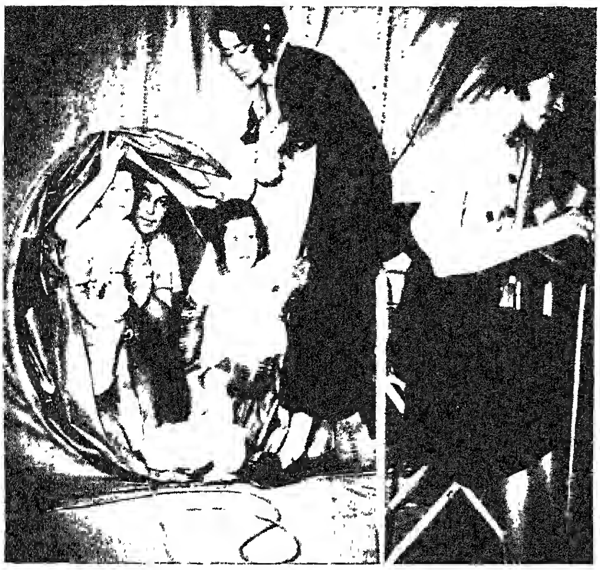


Cracks around the door of a gas-proof cellar being sealed by a soft rubber tube inflated by a pump



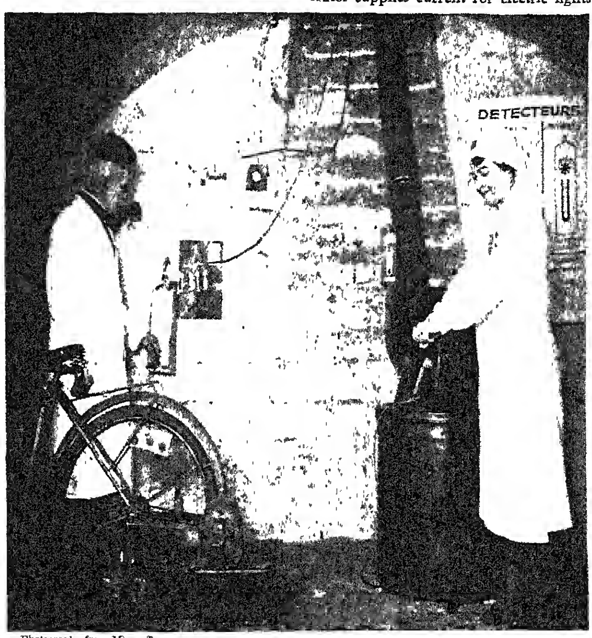
*Left:* Two Parisian motorcycle policemen fully equipped for carrying on their work during a heavy gas attack

Women and children in one of the temporary gas shelters which consists of a double wall of gas-proof fabric with a gas-proof entrance. These shelters may be quickly set up for protection of civilians or to provide emergency first-aid stations



Close-up of a completely protected volunte the first-aid gas squad in his gas-proof un

*Below:* Inside a large permanent gas shelter. The nurse is operating the air purifying apparatus. The cycle-driven generator supplies current for electric lights




Photographs from Mirzaoff

shelter for a number of civilians.

In every branch of building construction the fear of war gas is having its effect. Apartment house owners find that their rooms can be rented more easily if gas-proof cellars are available for the tenants. Hotels have more guests if similar protection is afforded. Even the subways are equipped with gas-proof cubicles. In fact, it is reported that the French Municipal Council recently passed a law making it obligatory for every new building to be equipped with gas-proof shelters which meet with the approval of army engineers.

It is said that throughout France nearly 10,000.000 gas masks are now available for the civilian population. In Paris alone 80,000 masks are ready for immediate service. But, Parisians say, 80,000 masks is a mere drop in the bucket! To supply the whole population of Paris alone the government must spend 300,000,000 francs.

To all this agitation for gas masks and shelters, sirens and gas drills, add the fact that the Police and Fire Departments are fully equipped for operating under gas attacks, that special gas patrols are available for dispatch to all sections of the city by motorcycle and automobile, and that ambulances are available on a moment's notice with nurses and doctors trained especially to fight poison gas, and you have a picture of what happens when the entire population of a country is so imbued with the idea of impending war that even the lowliest citizen is instructed in the procedure to be followed when and if the dreaded blow falls.

The photographs on these two pages, taken recently in Paris, tell their own dramatic story of the extent to which the authorities and private citizens have gone in their endeavor to be ready to fight successfully the insidious, invisible foe which, they seem to feel, may strike at any moment.

aving a concrete shelter, capable of using three persons. Note the conical ell- and bomb-deflecting top of shelter

# The Smooth Slide

By BARCLAY MOON NEWMAN

EVERY mystery of science has two aspects, the practical and the theoretical. No exception is the supreme mystery of modern research, the nature of life—what it means to be a live thing.

On the practical side, the investigation of cancer may well come first to mind. In this disease, the tiny units of living material, the cells, are not only alive but too much alive. They carry on the life reactions, grow, and multiply at far too great a rate. The excess growths which they thus produce are injurious, later painful, and finally lethal. As the efforts toward determining the secret of cancer and of its control have become greater and greater, yet ever end in failure, bioscientists in general have become more and more convinced that the cause of this disease is bound up with the enigma of life itself. For, the regulation of cellular metabolism (rate of biochemical activity), of increase in size, and of reproduction must now, more definitely than ever, be regarded as among the most profound phenomena of animate existence.

The search for the germs of influenza, infantile paralysis, sleeping sickness (encephalitis), and yellow fever has also penetrated to the obscure borderland between the living and the non-living. Each of these germs is a virus, that is, a parasite so minute and so simple in structure that biologists have been unable to decide whether or not it is alive. Here, again, the mystery of the difference between an animate and an inanimate being has practical bearing upon the conquest of disease. And a related problem is that of the phage, which is no bigger and no more complex than the virus, and which is capable of devouring bacteria, including some that infect man.

Furthermore, nothing is more practical than enzymes, the promoters of biochemical reaction which abound perhaps numberless within the body: like ptyalin of saliva and amylase of pancreatic juice which stimulate the digestion of starch into sugar; or like many another substance whose rôle is not the promotion of destructive reactions (such as digestion), but of constructive ones, such as the building up of intricate, living protoplasm out of absorbed nutrients. The possession of a specific enzyme permits yeast to ferment sugar to alcohol and use for its life activities the energy thus released. Recent research in Russia has shown that azotobacter, a distant relative of common yeast, has an enzyme which enables the organism to take free or uncombined nitrogen from the air and fix it, that is, synthesize nitrogen compounds, especially ammonia. An extract from crushed azotobacter has the same power, and therefore must contain the enzyme still active. This line of work may lead to the devising of less expensive methods of nitrogen fixation, essential for the making of explosives and fertilizers. Precisely what is an enzyme? An extraordinarily large and intricate molecule, straddling, as it were, the boundary between life and non-life.

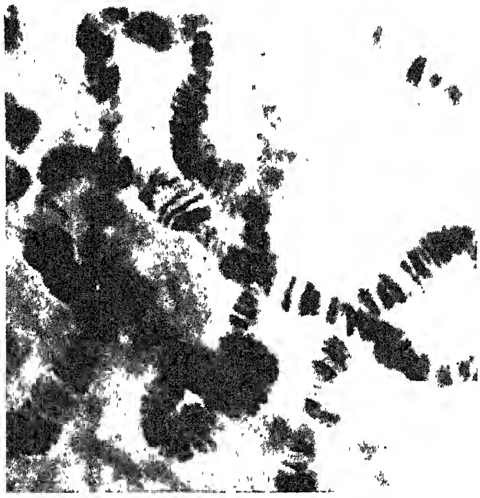


*Figure 1:* Very greatly magnified photograph of chromosomes containing subdivisions believed either to be genes or to contain the genes which seem to be the captains of life. From the genes each cell in the body is bossed. What *is* this boss?

In the last analysis, it is impossible to separate the practical from the theoretical, for it always happens that a worthwhile theory turns into a significant portion of human knowledge and is eventually put to some practical use. Today, it may seem impractical to speculate concerning the basic causes of aging and death, and concerning the basic factors of heredity and their suggested application to racial improvement, eugenics. Yet a Nobel Prize in *medicine* has been awarded to T. H. Morgan for his theoretical studies of inheritance in the fruit fly. And as we grow older, somehow the problems of adding to the years during which our minds are profitably active, and of lengthening the life span itself, do not appear so speculative as we once thought. Moreover, if we are thoroughly familiar with the tragedy of human weaknesses, such as crime, feeblemindedness, low mentality in general, and bodily defect, amid a giant civilization constantly threatening to get out of control, must we not regard eugenics as a field which it will pay to cultivate? Then, too, is it not excellent psychology to relax every now and then, and for a moment philosophize upon the wonders of the universe and even upon the meaning of life, the greatest of these wonders?

THUS, it may be that the theoretical aspect of the deepest mystery of organic nature can merit the notice of the busiest, the most practical, of men. For, thanks to the developing conception of the gene (Figure 1), it is now believed that the origin and meaning of life's physical chemistry, the processes of aging and dying, and the mechanism whereby the offspring reproduces the living pattern of the parent, constitute, all of them, only a single, grand consideration—the fundamental nature of life.

The gene, the unit of heredity, apparently belongs with the virus, the phage, and the enzyme within the twilight zone where the non-living world shades into the world of life. This does not mean that any of these four entities are ever found physically associated together in the same environment. Rather it means that they have so many properties in common as to make it logical to place them in the same category: of threshold beings, whose vital state is exceedingly doubtful. That is, the newer discoveries concerning these odd organizations of matter have demonstrated that there is no great chasm separating the organic

# UP TO LIFE

## Discoveries now Being Revealed, in the Twilight Zone between Life and Non-life, have Astonished the Scientific World . . . Their Practical Bearing

MANY men of science believe the revelations concerning the nature of life—the same ones described so ably in the accompanying survey—are destined to make the present time famous or classic in the future annals of science. Few scientists had been so optimistic as to predict, for our times, the solution of the major mystery and problem of all science—what life is—yet many signs seem now to point toward success. Better still, they point toward the simultaneous solution of several other baffling mysteries. The reader is urged to ponder well the solid content of this article.—*The Editor.*

from the inorganic. Each one of these four types of gigantic molecules is evidence that there is a gentle gradation of organizations ascending from inanimate to animate nature. There is a smooth slide up to life.

Thus there is, from electron to man, a hierarchy of combinations of particles. Electrons, protons, and neutrons unite to form atoms, which, in turn, join to produce molecules. The compounds so produced may be simple, as in the case of a water molecule, or exceedingly complex, as in the case of the proteins, like albumin whose molecules make up the largest part of egg white. And with increasing intricacy along certain lines of molecular architecture, there is steadily closer approximation to that group of properties which, all together, signify a living thing.

NO single activity of life is not characteristic of some example of non-life. Even an atom can grow: the heavier atoms have arisen from the lighter ones. Even an atom can repair an injury: if it has been mutilated by the loss of an electron, the loss can be made good. A crystal of table salt not only can grow but also can reproduce itself—of course in the proper solution, salt water. Certain oils, such as linseed oil, definitely exhibit respiration. They "breathe in" oxygen, carry on a slow oxidation, and "breathe out" carbon dioxide; meanwhile, the process releases, as in the body, a small quantity of heat. A copper wire shows memory: twist it back and forth, the twists are remembered, and finally the wire breaks. For that matter, an adding machine has greater powers of recollection (for figures) than a human being. Therefore, there is no simple test for life. Therefore, it is exceedingly difficult to say whether or not a borderline form, such as a molecule of a virus, is actually alive.

In 1857, a certain tobacco pestilence was first described. It was noted that the infected plants were stunted and that the leaves had a mottled appearance. This appearance of the leaves gave the disease its name: mosaic disease. In 1892, Iwanowski, in Russia, proved that the causative organism must be a virus, because he could pass an extract from the stricken plants through a filter with pores fine enough to hold back the smallest bacterium, and still the extract was infectious. What is the nature of a virus? What are its reactions? Does it consist of several molecules or only one? These questions became more and more important to medical pathology as the number of known virus diseases steadily increased.

*Figure 2:* **Dr. Wendell M. Stanley, to whom the American Association for the Advancement of Science has awarded its 1000-dollar prize for his noteworthy paper on virus research. He is 32 years of age**

In 1932, Stanley (Figure 2), of the Rockefeller Institute, set out to solve these problems. He chose to work with the tobacco-mosaic virus, since it is the easiest to deal with (especially as it is a *plant* infection), since more was known about it than about any other virus, and since it has long been regarded as a typical member of its class of parasites.

Pepsin is an enzyme (ferment) which is a specific digester of proteins. Stanley discovered that the infectious extract from diseased plants lost its infective power after being digested with pepsin. Hence it seemed likely that the virus is a protein. Certain salts are known to precipitate proteins. He tried out these precipitants on more of the fresh extract. Sure enough, the mixture clouded up and rained out some of its dissolved substances—the protein fraction. The extract, minus this fraction, again was no longer infective. The virus must be in the protein fraction, must almost certainly be a protein. Stanley then found a neutral solvent for the protein precipitate, made a solution, and again brought about precipitation, this time with an ammonium salt which caused the precipitate to emerge in the form of crystals. Repeated solution and crystallization ultimately gave a pure product, whose extreme virulence made it practically certain that he had isolated the virus. This parasite, then, shows up in the pure state as needle-like, transparent crystals (Figure 3). Each one of the millions of molecules constituting a single crystal turns out to be a germ of the disease.

IT has astonished the scientific world that a single molecule can be the causative organism of a disease. How can a crystal be made up of living molecules? Hitherto crystalline substances had been regarded, and for good reason, as inanimate—perhaps portions of animate beings, but not themselves alive. Yet there is no doubt that an almost infinitesimal bit of this dead-or-alive material, when placed in the living tobacco plant, soon shows its activity and "life," for the leaves wilt and die—while the virus feeds upon the living tissues and reproduces itself indefinitely.

In bulk, as thin glassy needles, the virus does not seem alive. It is presumably an inanimate protein, consisting of the elements carbon, hydrogen, oxygen, nitrogen, and chlorine. In the absence of other life, it is quiescent, does not breathe, and requires no food. It apparently is but an enormous molecule, highly intricate, certainly, but just a molecule, having a definite molecular weight, 17,000,000 times that of the hydrogen atom. Still, it is only biding its time, for it exhibits many activities of life once it has come into contact with life—the protoplasm of the tobacco plant. Decidedly, it must be thought of as a being from the borderland of animate exis-

tence, an organization just at the threshold of life. In it we discover how the stages of increasing complexity of atomic combination have at last scaled up to the realm of life.

Like the genes, which organize and direct the development of the tissues and organs in the embryonic animal or plant, the virus is able to master the reactions occurring in its host and turn them to its own account: that is, to make the substances of its host help in producing more of the very thing which is literally devouring the protoplasm of the tobacco plant, as in this case, or of man, as in the case of sleeping sickness and influenza. A morbid molecule can overshadow the life processes of the diseased organism and dominate them.

A gene can dominate the life processes of the cell which fabricates it, but to a happier, more constructive end. In every cell of every living thing, there is the central, spherical mass of regulative protoplasm, the nucleus. And in each nucleus, there are the deeply-staining, sausage-shaped chromosomes (Figure 1)—pure, concentrated, regulatory material, no more and no less than aggregations of genes—the building units of the chromosomes and the units determining the heredity of the individual. Now the chromosome is believed to be a chain of genes, each gene being a giant protein molecule probably somewhat similar in constitution to the virus.

IS the gene the sole seat of actual life within the body? We do not know, but there is much evidence in favor of this view. The gene is a protein, and only where we find proteins do we find life. Furthermore, there is no doubt that the gene is the unit of control of the bodily activities, from fertilized egg on until the death of the many-celled adult. The genes of the parents, except for an insignificant quantity of nutrient and protective substance, are the entire legacy to the offspring. Like enzymes, genes not only stimulate the biochemical reactions of the cell, and therefore of the body as a whole, but also control the direction in which a reaction travels; that is, the manufacture of the products, and the rate of these activities. Hence, according to the chemical structure of its genes, so goes the organism's structure. Our architecture is like that of our parents because each parental type of gene was able to make a copy of itself, or a near copy, and to hand down to us, by way of the chromosomal mechanism of the germ cells, certain of these duplicates, or near duplicates, of parental genes.

It is essential to mention that the delicacy and intricacy of molecules as high in the scale as the proteins are such that it is not always possible for one of these atomic groups to fabricate an exact likeness of itself. Such molecules are susceptible to the slightest alterations in their environment. A very minor shift in the position of an atom or two in a complex molecule means a new molecule, and sometimes a new creature. The tobacco-mosaic virus can readily mutate, or undergo a structural change, which gives rise to a different sort of infective agent, a novel variety. The bombardment of fruit flies with X rays alters the

*Figure 3:* **Photomicrograph of the crystalline tobacco mosaic virus protein, magnified 675 diameters**

parental genes so that the offspring have a far greater proportion of white eyes, for example, than of the more common red eyes. A gene mutation causes the mutation, white eyes. Evolutionists believe that such mutations, or chance variations, have been the raw material for evolution—Nature selecting the fittest of these variations or mutations for survival. In the twilight zone between non-life and life, many a great secret lies.

How smooth is the slide up to life? An inanimate virus molecule becomes animate when it touches live protoplasm. A living gene may suffer a slight transformation and become a lethal agent; some investigators think that this is what gives rise to cancer. Can a definitely inactive molecule—in its particular scheme of atomic arrangement always doomed to the avital or non-living state—can such a molecule be transformed to a very closely related structure, but one capable of a higher existence, on the plane of life? There is evidence that even this sort of modification can and does occur. Certain enzymes are autocatalytic; that is, they are capable of producing *themselves* out of completely inert substances, but ones quite similar to themselves. This is a kind of spontaneous generation. For example, a comparatively slight modification may automatically occur within the molecule of an inactive protein, which has no digestive power, and thus make out of itself an active enzyme, with the ability to effect a definite fermentation. Within a molecule, an atom leaps from here to there, an infinitesimal distance. Yet this insignificant leap is across a significant boundary, the one between death and life.

A BACTERIOPHAGE is either an enzyme or a gene on the loose, or a living thing as small as a virus. It too is considered to be a midway molecule, poised between life and non-life. As in the case of its three related forms, the most powerful lens fails to reveal it. Its outstanding characteristic is its ability to devour bacteria and perhaps other very minute organisms. Phages were discovered independently by Twort and d'Herelle in 1917, when these investigators noted that certain bacteria (which they had been growing in cultures) strangely disappeared, seemingly because of the attack of an invisible parasite. Like a virus or an enzyme, the phage can reproduce. A very minute quantity of bacteriophage, when placed into a bacteria culture of the appropriate variety, increases and therefore can kill a very large number of microbes. Also like a virus or an enzyme, they are specific in their action: a certain bacteriophage can destroy only certain kinds of microbes. Again, they are unable to multiply unless in the presence of living protoplasm, that is, the particular sorts of bacteria upon which they feed. It is possible that they are produced by the bacteria themselves, and may be true enzymes—non-living but able to dissolve the protoplasm which gives rise to them, perhaps as the result of some peculiar diseased condition among the bacteria. Northrop, of the Rockefeller Institute, has recently secured a bacteriophage in apparently pure form. It has been obtained as a sticky protein, similar to egg white. This particular phage attacks pus-forming bacteria known as staphylococci. A mere speck, once in a staphylococcus culture, can rapidly undergo propagation and finally annihilate the whole culture. Now that a phage has been for the first time isolated as a pure sample, we cannot fail to learn more about these fascinating entities of the realm wherein molecular organizations gradually take on the functions of an animate creature.

Thus, again we discover that Nature does not do things by big jumps. There is today a smooth slide up to life. We are reminded of the ascending process of cosmic evolution, in which matter and energy, at least on the earth, have co-operated in strange ways so as to produce gangs of atoms which live, move, and even feel and think. Now, man, who believes himself to be the highest of these products, is pondering the physical and chemical secrets which enable unorganized stuff to rise to the order of life. And the universe seems more than ever a unified cosmos—a place of infinite orderliness, however infinite in extent and wonder.

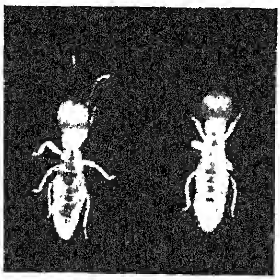
# YOUR HOUSE MAY HAVE TERMITES

By ALBERT G. INGALLS

THE writer had read here and there, including this magazine, articles on termites, emphasizing merely their beautiful home life without giving definite, practical information on finding them. He did not once suspect they were at the same moments lunching on his house. After going all through the work of getting rid of them, which required an expense of something under 200 dollars, he offers a few practical, preliminary hints for ascertaining whether a house is infested.

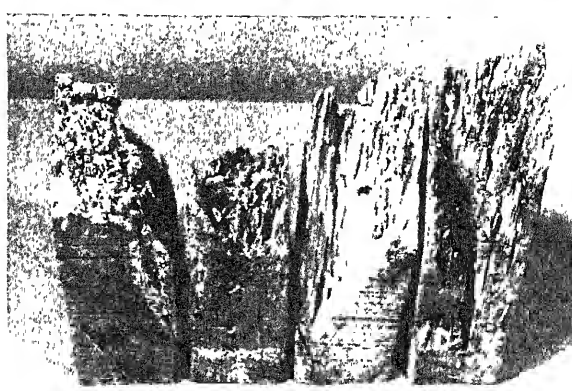
If termites are at work on your sills, studs, joists and floor, they will not announce themselves, for they are strictly inside workers. They are blind and highly light-sensitive, even to weak light. Just once do they come to the light, when a part of them grow wings and swarm, usually in spring or fall. Then they come out for a few hours as winged adults, fly a short distance, lose their wings and re-enter the earth. The earth is the termites' natural home. They lurk and drink below-ground, and in their natural state they go above-ground to lunch on available wood. To them, therefore, your house is simply a nice big dead tree. From earth to house and back again they run frequently and over definite, inside highways. If there is a gap between soil and wood, as is likely in the case of a house, this is where they may be detected, for they will not run across this gap without an artificial tube. Accordingly, the homeowner should systematically examine both outside and inside (flashlamp) of the foundation wall for things that look like narrow streaks of brown paint drizzling down. When broken, the streak will be found to have a hollow interior of perhaps the diameter of a pencil lead. It is a termite shelter tube. Now he knows he is "in for it." Other tubes may be located. These are termite trunk highways. While termites may be poisoned, such treatments are generally less satisfactory than methods which prevent termites from bridging the gap between earth and wood with these highways. This demands close attention to fine details.

Sills, joists and other parts may now be sounded for honeycombed interiors with a small bit.

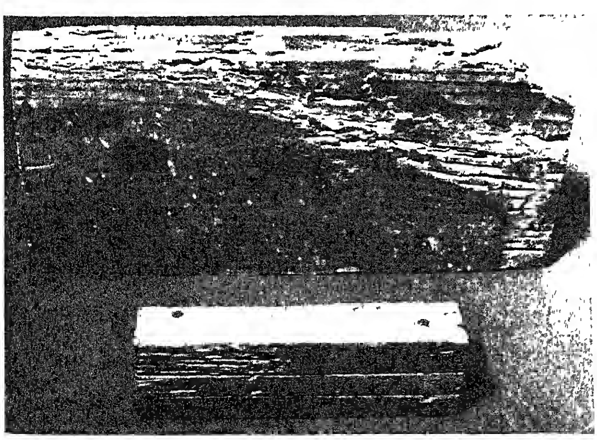


Workers, six times enlarged

Winged adults, five times size



Bottoms of coal-bin partition studs after some years of termite eating



Board from coal-bin partition. *Below:* An experiment. Two pieces of pine and one piece of cypress (at bottom) buried several months. Termites do not prefer cypress

It is bad medicine to become excited on discovering termites, or to let scare-you-all advertising stampede you. This writer's experience indicates strongly that the best immediate thing to do is to take ten days' time without doing anything except learning all about the manners and customs of termites. Then, when the professional exterminator comes, you will not be in the dark but able to look at the matter intelligently, know what he is doing, and why. Your house is extremely unlikely to "tumble down" in the meantime, even if someone says so. The Government publishes excellent termite literature: United States Department of Agriculture Leaflet 101 and Farmer's Bulletin 1472, obtainable from the Superintendent of Documents, Washington, D. C.

# ARCHEOLOGICAL OUTLINES

Painted pottery made by an as yet unnamed race which lived on the site of Tepe Hissar 6000 years ago

By JOTHAM JOHNSON
University Museum, Philadelphia

DAMGHAN is a placid town with a ruined citadel and a long covered bazar, lying perhaps a hundred miles southeast of the Caspian Sea, and separated from it by the massive Elburz range. From the foothills the spring of Cheshmeh Ali provides a small stream which, flowing past Damghan, wanders for a few miles to vanish in Iran's central desert.

Somewhere here lay Hekatompylos of the hundred gates, a capital of the Parthian kingdom—perhaps at Tepe Hissar, a group of mounds lying two miles east of the town, where also Ernst Herzfeld had picked up surface sherds of prehistoric pottery. It was inevitable that the University Museum would dig this promised land; with the Pennsylvania Museum of Art as co-sponsor, and Dr. Erich Schmidt as Field Director, the mounds of Tepe Hissar have been thoroughly investigated.

At the bottom of all things lay the poor remains of a nameless race. Where they came from, and what language they spoke, wait for a future miracle to solve. Yet we are not totally at sea. Their houses were made of a material more humble than sun-dried brick—layers of mud bound together with straw. The size of the town and its substantial buildings indicate that these people were permanently settled agriculturists, as is confirmed by their elaborate and therefore not readily transported pottery vessels, their small grindstones, their figurines representing sheep and cattle. We do not know that they had domesticated beasts of burden. They hunted ibexes in the mountains and gazelles in the plain, for food and skins. And by painting their pottery they won immortality.

As their most typical product this pottery has been intensively studied and elaborately classified. It was made on the wheel. In brown or dark grey on a red or brown ground, most of the designs are geometrical, hatched triangles, comb, wave and ladder patterns; a few specially prized show conventional ibexes and gazelles, birds, and even cats. The shapes also are standardized: cups, graceful bowls, jars, and broad-mouthed storage vessels. A few hand-made vessels survived from the most primitive occupation level.

Pottery figurines of domestic and wild animals in remarkable profusion were magical in purpose, to increase the flocks and lead the hunter to game. Spindle whorls for yarn spinning show knowledge of weaving, hence the earliest residents of Tepe Hissar were not limited to skins—or fig leaves. The bracelets, necklaces, and belts of the dead yielded 200,000 colored beads.

PRIVATE seals, of stone or terra-cotta, had geometric or wave patterns like the pottery, but one unique specimen seems to show two human beings engaged in some act of worship. Burial customs disclose belief in immortality. The dead were interred right in the town, under the house floors, without coffins, their legs bent up to save digging. With them were placed the seals and bead ornaments they had worn in life, pins to hold their celestial robes together, and bowls and cups of painted pottery for Elysian banquets.

A little copper was found even in the lowest deposit—garment pins with conical or pyramidal heads, daggers and arrow or light spear points; enough to lift them out of the neolithic into the transitional chalcolithic period, but by no means superseding stone for hammers, grinders, scrapers, mortars, and other heavy tools. Weapons, however, were few and there is no trace of a town wall.

This, then, was a typical settlement in northern Iran of the Painted Pottery Peoples, the first great migrating race of western Asia, now suddenly encountered at a number of sites. Strata equivalent to Hissar level *IB* (level I of this mound is at the bottom) occur at Rayy, Murteza Gert and Tepe Sialk, and similar or older strata are found from Mohenjo-Daro in India and Anau in Russian Turkestan to Susa in Elam, al Ubaid and Jemdet Nasr in Babylonia, Tepe Gawra, Arpachiyah and Tell Halaf in northern Mesopotamia, and Alishar in Anatolia; in the current number of *Iraq* Sir Aurel Stein tells of his survey of ancient Pars in the winter of 1934-5, during which he discovered a score or more of new chalcolithic sites with painted pottery.

Dr. Schmidt observes that a proto-Elamite culture datable from parallels in Susa and Sumer overlies the Tepe Sialk stratum corresponding to Hissar *IB*; that would date it and its homogeneous cultures to about 3800 B.C., comparing well with the closing phases of the Painted Pottery Peoples at Tepe Gawra as dated by independent comparisons; Hissar *IA* must reach back long before. [Excavations at the great mound of Tepe Gawra were described by the author in SCIENTIFIC AMERICAN, October, 1935, pages 178-179.—*Ed.*]

We would expect to have passed below the chalcolithic period into the neolithic, but copper now proves to occur to such astonishing depths that it becomes risky to apply the term "neo-

# IN PREHISTORIC PERSIA

## The Excavation of Sites in Iran (Persia) Makes it Possible for the First Time to Piece Together a Partial Outline of Persian Archeological History. Tepe Hissar, an Ancient City Mound at Least Six Thousand Years Old, Was Once Inhabited by the Painted Pottery People of Unknown Identity

lithic" to any culture yet known in western Asia. Nowhere in Iran or Mesopotamia, in any case, has any New Stone civilization turned up beneath remains of the Painted Pottery Peoples, though paleolithic cultures—Mousterian and Aurignacian—have been found.

In time newcomers introduced a new scale of living and a wheel-made burnished grey pottery by which to be recognized forever. For a few years the two types are found side by side; then painted pottery disappears. Thus are Hissar II*A* and II*B* differentiated. The familiar Hissar I shapes, however, survive practically without change throughout Hissar II, implying that the new culture was assimilated peacefully to the old. And, in fact, nowhere is there a sign of struggle or of the torch.

Walls were straighter and cleaner, living quarters improved by the introduction of large sun-dried bricks of mud and straw. The tombs supply more elaborate jewelry, now with lapis lazuli. Before the close of II, copper seals begin to appear, together with numerous daggers, fine garment pins, bracelets, and other ornaments; also a mace head beautifully worked with an engraved zigzag design, as well as objects of silver and lead. Hissar II's great step forward was in metal-working, and, considering how long it lasted, we may be surprised that it was not greater.

Hissar III is also characterized by grey pottery. Probably there was a peaceful invasion and the improvements over period II—the new series of pottery shapes and the wealth of metal objects and alabaster furniture—are to be credited to new and wider relations between Tepe Hissar and neighboring cultural centers; but we are at some embarrassment to explain the amazing disappearance of the potter's wheel, probably the only record of a race which experienced its benefits only to abandon them. Wheel or no wheel, each vase is a ceramic masterpiece, and the axiom that hand-made pottery is more expensive to own is borne out by the frequent discovery of bottles broken and repaired with string. Here appear also a few painted vessels, perhaps for ritual use, surviving from Hissar I.

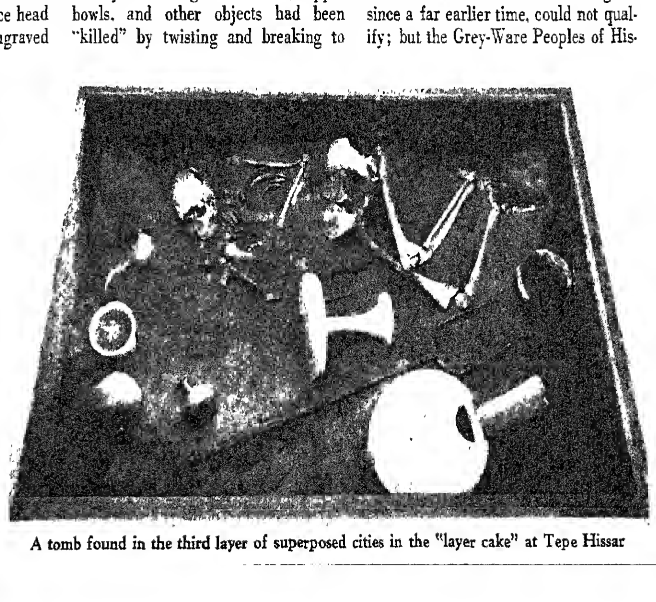
MOST of the bronze objects come from an extensive cemetery on the main mound of Tepe Hissar. A tomb set up in the University Museum shows the typical gear of a warrior: a "bident," or two-pronged copper spear wrought in one piece with its handle, a spear and helmet, his farm tools, mattock and chisel, a wand, a string of beads, and prized possessions to furnish his house in the other world; a spouted bowl of silver, two bottles of grey pottery and a jar, a small table, top and pedestal in one piece, and a portable table, the top cut out to make a hand-grip, the pedestal separate, all of alabaster. In another grave were arrow-heads of chalcedony. In some graves bidents, copper bowls, and other objects had been "killed" by twisting and breaking to make sure they would really go with the deceased.

The grave of a little girl had six silver cups and pitchers, crushed by the weight of earth above them. Lead was a precious metal; cups were made of it. And finally a little gold appears. Seals tend to be of copper or alabaster, but a number of cylinder seals in Hissar III are probably importations from Mesopotamia. Human figurines in silver, copper, and alabaster are found.

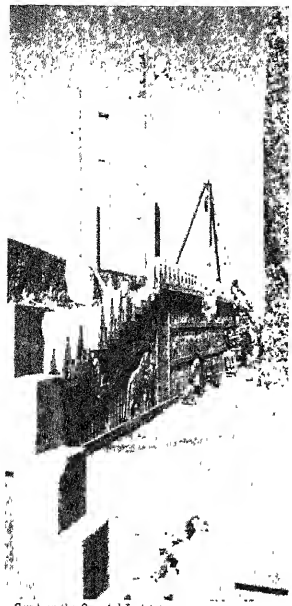
Dr. Schmidt has divided Hissar III into three sub-levels, *A*, *B* and *C*. Of these, *B* ended in fire and the sword. One room contained the skeletons of a dozen people who had tried to escape by way of a stairway to the roof, but had been beaten back and perished in the flames. Communal burials imply further details of this somber story. Yet enough survivors returned to rebuild and continue Tepe Hissar's cultural development.

At this point the philologists deserve a brief hearing. They now generally agree that the first "center of diffusion" of the Indo-European languages, which include the Iranian and Indic groups, was off to the northeast of the Caspian Sea; that about 3500—3000 B.C. their advance guard swung around the east and south coasts of the Caspian to settle in what later was known as Iran.

It would be interesting to connect these migrants—highlight of linguistic studies—with one of the epochs of Tepe Hissar. The Painted Pottery Peoples, who had been known in these regions since a far earlier time, could not qualify; but the Grey-Ware Peoples of His-



A tomb found in the third layer of superposed cities in the "layer cake" at Tepe Hissar



Courtesy the Oriental Institute

**Wing of staircase recently discovered by the Oriental Institute in the palace of Darius at Persepolis**

sar II might, and attempts to confirm this identification will be made (over countless dead bodies) in the years to come.

THE systematic exploration of key mounds along the supposed highway of migration, to catch this race in motion if possible, has begun at two sites. Tureng Tepe, near Asterabad north of Tepe Hissar, was dug by Frederick R. Wulsin for the University Museum in 1931; he found a grey-ware culture perfectly comparable to Hissar II and III. Dr. Schmidt's excavations at Ragha or Rayy—more famous as Rhages, source of some of the world's loveliest pottery—are now in course and no report is available, but it is understood that, in addition to the primitive village of the Painted Pottery Peoples mentioned above, he has discovered a well-defined stratum of the Grey-Ware Peoples, superior in culture to Hissar II, as we might expect, and inferior to Hissar III.

If further exploration brings final proof identifying a migrating Indo-European tribe with a given copper-age culture, the combined resources of linguistic science and archeology will be pooled to work on this typical Aryan[1] problem.

After Hissar IIIC, which closes soon after 2000 B.C., the mound was deserted. At this time Iranian culture seems to have lost its distinguishing features, and to have entered a long period of dependence on Elam.

Elam was not part of the Iranian plateau, but was the wide mountain range between it and Babylonia. The Elamites spoke a non-Iranian—not even Indo-European—language and belonged to a different racial stock entirely. But they knew writing at a remote period; by 2400 B.C. they figure prominently in history, and have often (for example, in George G. Cameron's misleadingly titled new "History of Early Iran") been made to pose as spokesmen for the Iranians.

One of their chief cities, Shushan, exhaustively dug by a French mission, is the greatest scientific site in the world; in some opinions Susa I goes back to 5000 B.C.—almost as old as Tepe Gawra's still untouched level 20. Still its records are by no means consecutive and during the second millenium B.C. we are permitted only occasional glimpses at a tug of war with Babylonia. Elam never quite became an empire, and when Agamemnon's Achaeans were parading before dusty Troy, Susa seemed also on the road to oblivion.

YET in the time of the last Assyrian empire there was a last rival monarchy in Susa, extinguished with the city's destruction about 640 B.C. To these centuries belong the highly decorative bronze bits, chariot pole and hub ornaments, adzes and axes, daggers, pins, and bracelets which, dug from the tombs of Luristan by native tomb robbers, came on the market in thousands a few years ago and received wide attention, several American museums securing representative collections.

The sporadic discoveries there of bronze objects engraved with the names of early kings of Babylonia—like the bowl of Shargali-sharri who ruled at Agade about 2600 B.C., now in the University Museum—do not prove that the Luristan bronzes run back to that date, as some have thought. They may rather be taken to show that Elam was not always unsuccessful in her wars with Babylonia, or that in 700 B.C. Babylonia maintained a lively trade in her own antiques among visiting hillmen.

Erich Schmidt's official report on Tepe Hissar will appear this month (May), and for next winter are scheduled his account of archeological exploration by airplane in Iran and the sumptuous "Survey of Persian Art" edited by Arthur Upham Pope. In 1938 will appear Neilson C. Debevoise's "Political History of Parthia" and Schmidt's preliminary report on Rayy: five works of first importance.

It is a great moment in the archeology of the Iranians, and it's about time. After all, they occupy the most fascinating zone left for the new generation to explore. They have sponsored a series of artistic peaks which have never been dull and often Olympian. They hold the key to the problem of Indo-Iranian migrations, the solution of which will advance the study of Indo-European origins by a generation. And in the absence of written testimony, which makes them prehistoric right down to the Neo-Babylonian period, they become a field laboratory without peer. The history of early Iran will be written with the spade alone, a monument to archeological method or its lasting disgrace.

**The start of excavation of a mound at Rayy, which is in progress. A Parthian temple, a Painted Pottery village, and a Grey-Ware level have been found**

[1]The name "Aryan," was not coined for Hitler's personal use nor has it any more to do with blond Nordics than has the swastika. When the historical Iranians or Erani needed a distinct name they spoke of themselves as the *Aryanam Khshathram* "Empire of the Aryans." In the 3rd Century B.C. the Alexandrian geographer Eratosthenes comprised under Ariana those parts of the old empire which had then regained independence. But this is a far cry from 3000 B.C. If Hitler is aiming at an Aryan ideal he would derive profit but little comfort from a trip in Iran.

# GLUED ARCHES

## For Building Construction Stand Rigorous Tests

By MARY BRANDEL HOPKINS

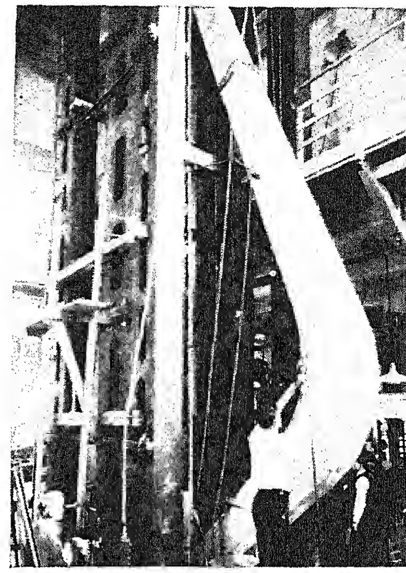
AS a test of glued-arch building construction, of which economy of cost and space are the outstanding merits, the United States Forest Products Laboratory at Madison, Wisconsin, has during the past year subjected one of the arches in a large service and storage building to a constant weight of 31,500 pounds from 315 sandbags on its roof. This weight, 50 percent in excess of that which would have to be borne by the arch were the roof blanketed with a drift of snow weighing 30 pounds per square foot, has deflected the roof peak, in all those months, the remarkably slight amount of only one and one tenth inch. The outward spreading at each shoulder of the arch is only about one-quarter of an inch.

While tests made in the laboratory's million-pound testing machine before the arches were built into the structure left no question as to their ability to carry the load that would come normally, the sandbag experiment is being conducted to measure the deflection from an extra load.

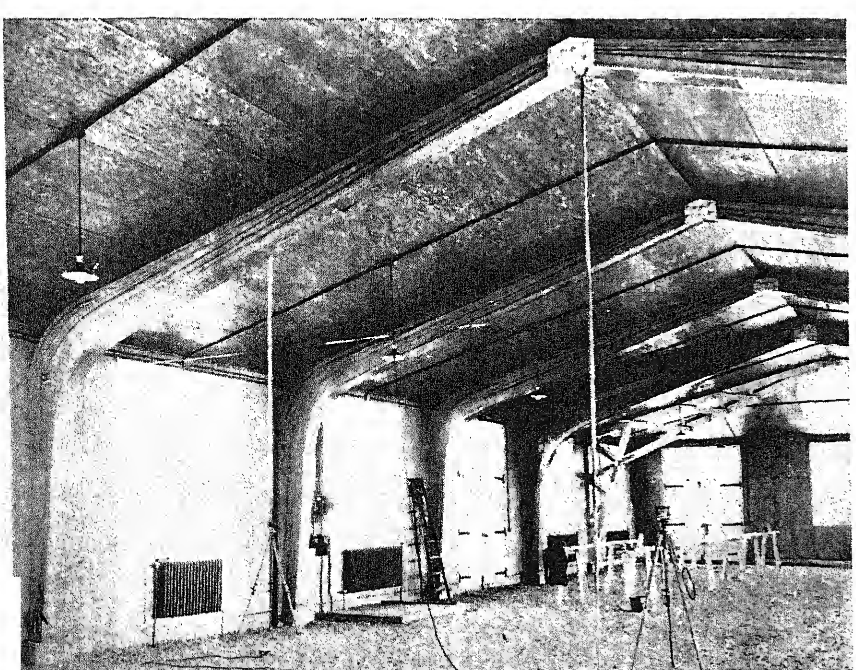
The arch supporting the burden is one of five used in the 160- by 46-foot building, which is 12 feet high at the walls and 19 feet high in the center. The arch was formed by assembling a group of thin boards with water-resistant casein glue and bending them against a form of required curvature, where the assembly remained clamped until the glue had set. Similar groups of laminations of 9/16 inch material were added to increase the width to $11\frac{1}{2}$ inches and the thickness to 12 inches at the base, 24 inches at the knee, and 8 inches at the apex.

The advantages of construction with the laminated glued arch are many. Seasoning of small pieces of material such as are utilized in the construction avoids the checking and warping involved in drying larger pieces. Larger and longer members than are generally available as single pieces are made possible. Members of any desired curvature may be provided. Material produced from small trees can be utilized. Laminations can be so arranged as to minimize the results of defects. Striking economy of material results from tapering members so that their cross sections at various points in the length are no greater than required by the imposed loads. More artistic appearance is possible than with some types of construction. Lower, and consequently in some instances thinner, side walls, together with reduction of waste overhead space and resultant saving in heating and air conditioning are other advantages.

Twenty-eight buildings in Wisconsin, Michigan, Minnesota, and North Dakota employing glued-arch construction already have been erected or are in process of construction. They include the gymnasium with its wooden arches of 60-foot span in the new 350,000-dollar high school in Racine, Wisconsin; the gymnasium with arches of 58-foot span in the high school at Fish Creek, Wisconsin; the high-school gymnasium at Peshtigo, Wisconsin, with 63-foot span; and the high-school gymnasium at Ashley, North Dakota, with 68-foot span.



A glued laminated wooden arch in the million-pound testing machine



Interior of building, showing instruments for checking deflections of the glued wooden arch under load. *Above:* The sandbags piled on the roof during the test

# Animal Technicians

By S. F. AARON

Drawings by the author

THE statement that expert artisans existed long before the advent of mankind has often been truthfully repeated. It is also very probable that human discoverers and inventors have been very largely imitators, having as examples principally the work of birds and insects.

Thus we have been given lessons in masonry, pottery, pulp compounds and paper making, combinations of clays and vegetables, spinning of threads, bridge construction and framing, tunneling, underground dwellings, carpentry; and, with limitations, weatherproofing, weaving, kite-flying and airplaning, stitching or sewing, diving and underwater work, even dredging. And, above all, cementing or gluing.

But this last—the uses of adhesive material—seems to have largely escaped the observations of students and, while its proficiency results from inherited development and the materials are of the various artisans' own secretions, they have an advantage over those which man must compound for his uses.

The only reference that can be made to this use of cements and glues involves the secretions of saliva peculiar to the birds and insects that employ it with such remarkable results, and without which many species could not have existed.

It seems odd that, when having numerous examples of construction before him, of birds, beasts, and bugs, very primitive man did not generally adopt the evident methods that could have been most needful and which was later done.

GLUE-LIKE, stoutly adhesive, hardening, waterproof, and plentiful as an admixture for building material, the saliva as secreted by many insects and a few birds is without its equal in the inventions of mankind, or in anything that can be employed by the four-legged relatives of mice and men. The use of saliva as a glue has reached its highest development by the edible nest-making swallow of the Orient, by the silkworm, and by the web-building spiders. As far as the chemists have ascertained—and specific analyses have been made—there is very little difference between the various salivas used by a few birds and many insects as an adhesive material. It is probable that the robin and other thrushes employ a very limited amount to aid the mud and clay to adhere to the twigs and grasses of their nests, and that it differs not at all from that which the longicorn beetle larva mixes with its gnawings of wood to form the powder post plugs to its burrows. The caddis-fly puts twigs together under water with a material of the same nature and composition as is used by the chimney swift to make its twigs stick to each other and to the inner sooty wall of chimneys.

*Figure 1:* **Three types of the mason wasp nests and the mason at work. *1:* Larva, maker of the silken cocoon. *2:* The cocoon, about half size. *a:* Sericin lining of cocoon. *b:* Human hair in comparison. *c.* Outer silk cover of the cocoon, magnified about 13 diameters**

The paper nest hornets and wasps mix with their wood fiber pulp a material that is the exact counterpart of that employed by the mud mason wasps and their larvae to form their cocoons within the mud cells. So also do the bag-worms fabricate their conical, movable, twig-encrusted domiciles, the caterpillars of many moths make their silken cocoons, and the tiny parasitic ichneumon maggots surround their delicate bodies with an envelope having the precise shape and character of the silkworm cocoon from which commercial silk is spun. And the basic material does not differ from the delicate web strands of the ever-busy spiders and the evenly distributed saliva that permits the barn and eaves swallows to fasten their bulky nests to vertical surfaces.

But there is a variation in the manner in which this saliva is applied. Silkworms condition it into threads so delicate that many are required to make a strand as heavy as a human hair. It is emitted through spinneret tubes in figure eight form by motion of the caterpillar's head and from the outside of the cocoon wall inward. But first there is spun an indiscriminate mass that has been termed floss. When the wall of the cocoon is finished, the saliva is spread in a varnish-like sheet over this inner surface. The term sericin is applied to this gummy material, also to the excess saliva that sticks the spun threads together.

THE larval cases of the mud mason wasps (Figure 1) are made up outwardly of a very fine silk and are lined with a coating of sericin through which fine fibers are spun, much as hair or jute is mixed with plaster to give it strength. The cocoons of certain tropical moths allied to the silkworm consist of a continuous, thick, solid wall becoming exceedingly hard in order to withstand enemies.

The edible nest of the Asiatic swallow is of the character of sericin and the Chinese think it no more out of the way to eat it than we do to partake of predigested honey.

The spiders reach the perfection of a varied development in producing their webs of a material, from abdominal spinnerets, that has the elements of salivaceous exudations. But while all others are of a sticky nature only when applied, and dry hard and smooth, some of the web strands of spiders are also of a viscid character for the purpose of holding victims that come into contact with them.

This sticky web is employed by the orb weavers; the snares of other species depend on the tangle of cross strands to hold those insects that chance to leap or fall into them.

The amount of sericin expended in nest building varies with the needs of the various species. The quantity seems not in the least to be influenced by temperature, but is governed by the enemies that threaten, or the necessity for extreme adhesion. Thus the cocoon builders guard against birds, mice, lizards, ants, and insect parasites, the mason wasps against such inquilins as the an-

threnids (which include generally those small beetles, the larvæ of which feed upon dead insect matter and occasionally on their living relatives) and various fly larvæ that devour helpless grubs and pupæ, also getting their living from dead insects and such matter as wood, feathers, and skins. The amount of saliva expended by the chimney swift is far greater than that necessary for the swallows and other birds that use mud, and the potter wasps (Figure 2) have reason to reinforce more strongly the thin walls of their delicate jug-like larval homes than do the mud masons with their much heavier construction that might be supported without cement.

The anatomy of birds other than the swifts does not disclose more than a normal development of the salivary glands, nor have any of these species been seen actually to emit saliva as an aid to nest building; but that it is made use of is beyond doubt, because of the adherence of the earthen material to the face of wooden timbers and rock cliffs, also by tests of strength: If a piece of wet clay from which the robin gathers its mud be tested it breaks easily, but an equal piece from the nest containing no grass or other fiber is much stronger and more adhesive to any surface. The same experiment, with like result, may be made with clay from the cells of mason wasps.

IT is most illuminating to the nature student and fabricator to watch the nest building of those birds that put together structures calling for extreme skill—acquired most largely by heredity, of course, and bolstered also by individual application and ingenuity. The orioles and the vireos are extreme instances and it has been my privilege, by both chance and special effort, to make close observation of several constructions from within a window where my presence was unsuspected.

As weavers the vireos take second place, but with the application of combined materials they attain equal results, making more compact and stronger nests that better outlast severe weather. I cannot discover that the orioles of our eastern states' species (the Baltimore and the orchard orioles), or that near relative of the southwest, Bullock's oriole, ever employ saliva, or anything in the nature of a cement or mucilage. They depend solely on a most admirable although irregular interweaving, and the manner in which this is done is by simply thrusting a loop—rarely an end—of the grass or other fiber used, into and through the mass; going inside the nest and pulling it through. The beginnings I have not witnessed, though I have seen the orchard oriole add fibers of long grass to the attachments on the twigs, first threading the strand into the nest bulk, then with

*Figure 2:* **The jugmaker wasp and her pottery. One jug cut open to show the paralyzed caterpillar food of the baby wasps (1⅛ diameters)**

admirable precision passing it twice around the branch.

Once I watched an orchard oriole twist a stalk of grass around a pear tree limb within a dozen feet of my study window, then discard the situation for one lower down that I discovered many days later. But I have watched at intervals a red-eyed vireo build its fine, pensile nest from start to finish not eight feet from a window and, from this and an examination of many nests, there can be no doubt that saliva is used. I did not see the bird actually produce the slightly gummy substance; that must be nearly invisible. But I did see the little mechanic almost mysteriously attach the ends of short strands of grape vine bark to the sides of the already thickening nest wall, and I afterward found the exact spot and many others in that and other nests, with bits of leaves and twigs on the external surface adhering thus. This process is no more peculiar than the employment of saliva to aid the adhesion of particles of earth and mud used by the robin, woodthrush, phoebe, and the barn and eaves swallows.

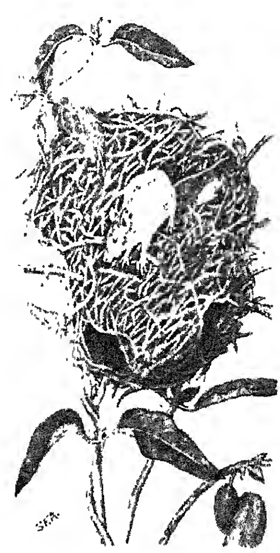


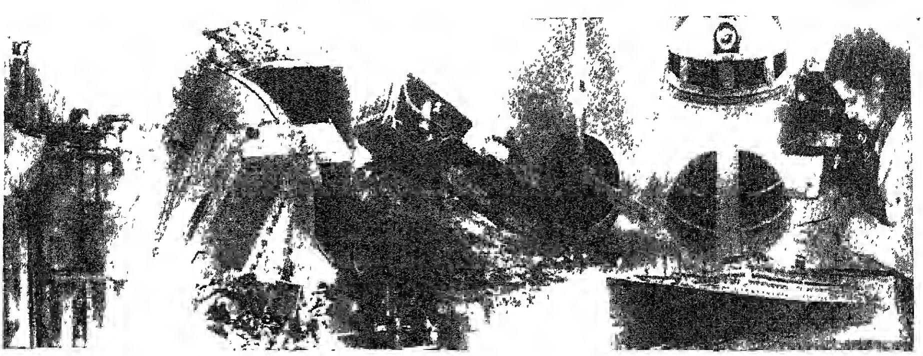
*Figure 3:* **The harvest mouse and its nest. No glue used here: only extreme quadrupedal manipulation**

The entire process is of the utmost painstaking, and so diligent was the bird that the nest was completed in the long daylight hours of two days. This included the gathering of materials, in which she was absent sometimes for half an hour. The male took no part in this labor. There was little interweaving, but principally a laying on from without, the external wall steadily growing thicker and higher from a well begun foundation of platform-like construction suspended by two-inch cables of grass, weed bark, and rootlets. The softer lining was placed at the last.

VERY similarly constructed to that of the orchard oriole is the bulkier, globular nest (Figure 3) of the harvest mouse, a little beastie most common in the south and southwest. It is not known how these master builders among the mammalia go about the work of construction, but they make the job a comparatively short one, using long grass and slender weed stalks that are less interwoven than simply overlaid and wound around and about the supporting weed stalks, or the twigs of bushes. There are several entrances, and the interior is further made cozy with such soft materials as milkweed down—this mouse having learned the value of those materials that the birds use.

The geometrical webs of the orb-weaving spiders have been too often and minutely described to require repetition. They equal or surpass in some respects, especially in the methods of approach or beginnings, anything that man has done. Those webs of other species are but multiplied strands to suit the spaces chosen. But all spiders can do better than these webs, by making stout silk bags to hold their eggs and young. These roughly globular containers have well defined openings for the escape of the little ones.

We have something yet to learn from nature's methods. Some of our imitations have been inferior; for example, rayon, the preservation of foods, cements and varnishes as previously explained. If we could devise a material as good as chitine (the exo-skeleton of insects) and make it bug-proof and not too expensive, we should have obtained a valuable commodity for many uses.



# THE SCIENTIFIC AMERICAN DIGEST

Conducted by F. D. McHUGH

Contributing Editors

ALEXANDER KLEMIN
In charge, Daniel Guggenheim School of Aeronautics, New York University

D. H. KILLEFFER
Chemical Engineer

## 70,000 Clocks Adjusted Free

A DOUBLE file of giant transmission lines carrying 275,000 volts marches across desert and mountains—from the great power plants at Boulder Dam to the City of Los Angeles.

The 266-mile line brings vast reserves of low-cost power to serve the homes and industries of Los Angeles, delivered at a frequency of 60 cycles, replacing the former 50-cycle electricity serving the quarter million meters on the lines of the city-owned Bureau of Power and Light.

One of the results of bringing Boulder Dam power to Los Angeles was the hiring of 75 clock experts

With the delivery of Boulder Dam power to Los Angeles the citizen-owned utility faced the problem of adapting consumers' equipment for satisfactory operation on the higher frequency.

The job is now completed and stands as one of the year's outstanding examples of efficiency. Without cost for adjustment and without major inconvenience to consumers, the change in frequency has been completed. Thousands of different items of household and industrial electrical equipment, ranging from barber poles and hair clippers to 750-

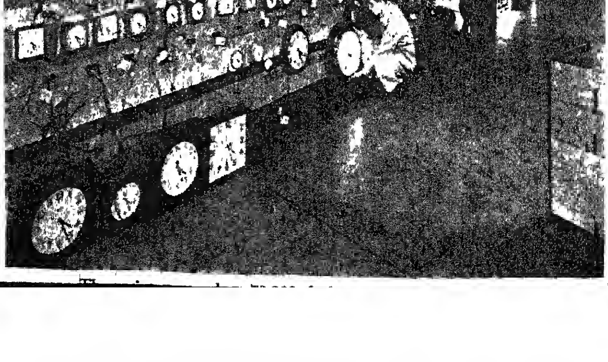
been adapted for operation on Boulder Dam's 60-cycle power.

Chief among the many complex problems now smoothly solved, and most interesting from the standpoint of the man on the street, was the job of caring for more than 100,000 synchronous electric clocks. Los Angeles' clocks kept time on 50-cycle electricity, but with the change to 60 cycles each 50-cycle clock would speed up, gaining 12 minutes in each hour.

After careful study of the situation, the city's Bureau of Power and Light announced that it would be its policy that no one should be allowed to suffer because of the change. The Bureau, therefore, began a survey of its 285,000 meters to check up on the number of appliances on its lines that would be affected. The company found that its consumers owned nearly 125,000 electric clocks that based their time-telling on a frequency of 50 cycles.

The Bureau of Power and Light proceeded to make preparations for the job of re-adjusting the 125,000 electric clocks. The problem was made especially complex by the fact that the utility discovered more than 250 makes of electric clocks with almost as many methods of construction and gearing. It was also learned that the manufacturers of almost 200 brands were no longer making clock parts and had abandoned the business entirely. For many of the obsolete models it was impossible to find substitute parts. The Bureau contracted with a leading firm of clock experts, the E. W. Reynolds Company, for the making of clock adjustments. So immense was the task that it was necessary to equip a special three-story building containing over 80,000 square feet of space for the extensive job of collecting, inspecting, and repairing all clocks.

The Los Angeles territory was divided into twelve districts, each with nine to nineteen district depots. Owners of synchronous electric appliances were notified and requested to bring their clocks and motors to the neighborhood depot. There the clocks were carefully checked as to condition and then sent to the central depot. From there the readjusted clocks, cleaned by compressed air, given a special oiling, tested



and guaranteed to run satisfactorily for 60 days, would be returned to the householder within five days. It was soon found that the task of resynchronizing the clocks was in a great many cases so difficult that the only solution was the substitution of an entirely new rotor. The Bureau, therefore, contracted with the pioneer Warren Telechron Company for approximately 50,000 clock rotors designed to operate on 60-cycle current. These units in most cases were connected with the works in the consumer's clock with a minimum of effort.

One of the results of the operation has been the hiring of 75 special clock repair experts and many other men to handle stock room detail.

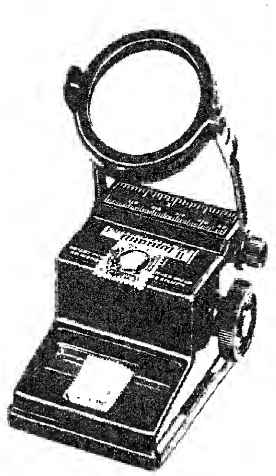
### STRONG

GLASS fibers have been made having a strength of approximately 2,000,000 pounds per square inch, although the typical strength of glass in rods is only about 20,000 pounds per square inch.

## For Stamp Collectors

WHILE stamp collecting is a most interesting and instructive hobby, its devotees have a complicated job of measuring exact sizes of stamps, counting perforations, and detecting watermarks. This can be a very tedious job.

An accompanying illustration shows a new device designed to make this hobby an ideal relaxation. It is provided with an adjustable magnifier, a scale, and, perhaps most important, a perforation counter. This latter feature consists of a hand-operated drum, on which are marked bars to match the perforations of stamps being examined. This drum is rotated until a set of bars exactly matching the perforations falls beneath the edge of the stamp. The number of perforations are read at one end. The watermark tray in front of the device keeps its rich jet color permanently, an important requisite in identifying faded watermarks. The complete unit is produced in black Bakelite molded.



Relaxation for stamp collectors

## Saving Our Wilderness from Ourselves

"THE fight to save the wilderness has grown during the past ten years from the personal hobby of a few fanatics to an important, nation-wide movement. All over the country," according to Robert Marshall Dobbins and Althea Dobbins in *The Living Wilderness*, organ of the Wilderness Society with headquarters in Washington, D. C., "people are beginning to protest in a concerted manner against the invasion of roadless tracts by routes of modern transportation. Encouragingly enough, a number of these protests have been heeded, and several splendid roadless areas have thus been saved. Others have been preserved by federal and state officials before any protest had to be launched. Yet others, unfortunately, have been invaded either because nobody happened to realize that invasion was imminent, or because no one was aware that there was a significant area to be saved.

"The accompanying map indicates those forest areas in the United States of 300,000 acres or more and those desert areas of 500,000 acres or more which are not yet accessible to mechanized transportation."

The following is the platform of the Wilderness Society:

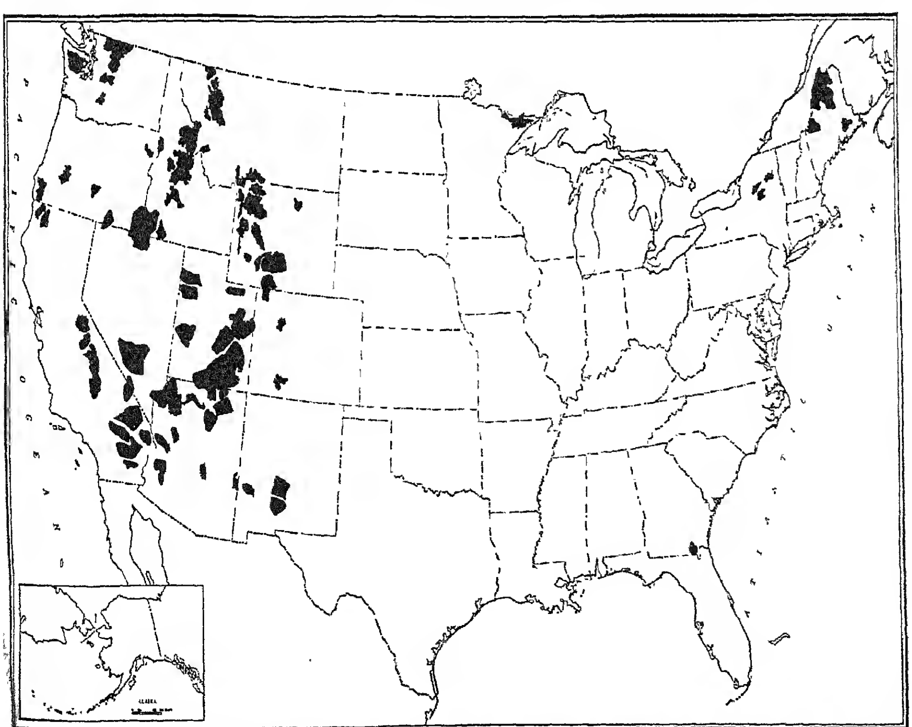
That the wilderness (the environment of solitude) is a natural mental resource having the same basic relation to man's ultimate thought and culture as coal, timber, and other physical resources have to his material needs.

That the use of this resource should be considered a public utility and therefore its commercialization should not be tolerated.

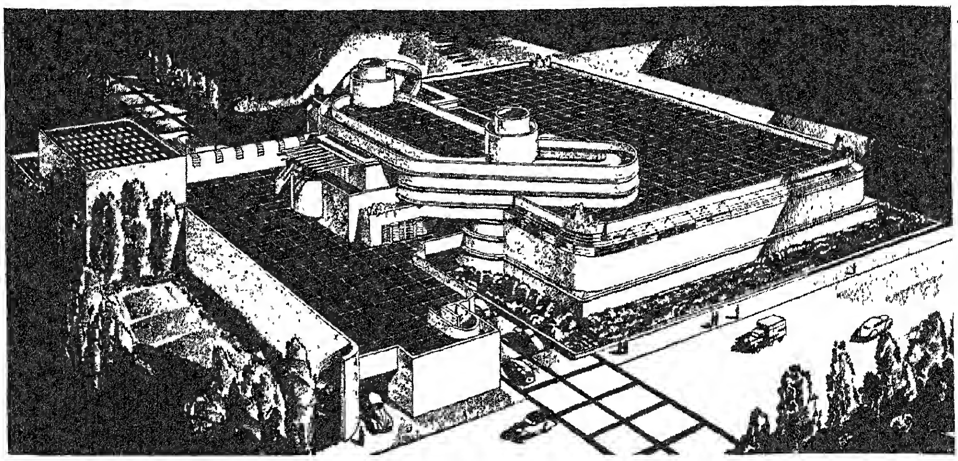
That the time has come, with the brutal-

### DOCTORED

AMONG the flavoring agents added to cigarettes are cocoa, chocolate, licorice, ginger, cinnamon, tonka, vanilla, coumarin, molasses, rum, brandy, maple syrup, angelica, oil of anise, oil of juniper, oil of cloves, honey, sugar, and organic esters.



Forest and desert areas in the United States which are inaccessible to mechanized transportation



Exterior of an unusual office building, designed for utilitarian purposes. Note the "nostrils"

izing pressure of a spreading metropolitan civilization, to recognize wilderness environment as a human need rather than a luxury and plaything.

That this need is being sacrificed to the mechanical invasion in its various killing forms.

That scenery and solitude are intrinsically separate things, that the motorist is entitled to his full share of scenery, but that motorway and solitude together constitute a contradiction.

That outing areas in which people may enjoy the non-primitive forest are highly desirable for many pent-up city people who have no desire for solitude, but that such areas should not be confused in mental conception or administration with those reserved for the wilderness.

That, since primeval succession can never return once continuity has been severed, it is manifestly the duty of this generation to preserve under scientific care, for the observation, study, and appreciation of generations to come, as many, as large, and as varied examples of the remaining primitive as possible.

That the wilderness remaining in America has shrunk to such a small remnant of the country's total territory, that what area does remain is all-precious and its preservation a vital need.

That encroachment upon our remnant American wilderness in any one locality is an attack upon the whole and creates an issue of national moment and not for local action alone.

That since the invasion of wilderness areas is generally boosted by powerful, country-wide organizations, it is essential that individuals and groups who desire to preserve the wilderness must unite in a country-wide defense.

The editors of this magazine, agreeing with the aims of the Wilderness Society, have joined it, and urge others to do the same. "Except in communities living by the axe," the Society organ states, "newspapers are all with us."

## Gas Wells for the Florist

LOOKING for one thing only to be disappointed by finding another is the lot of man. Seldom is the thing found of more value than that sought, although there are exceptions. The history of the oil industry is full of incidents where wells were drilled in search of "black gold" only to find water. This process was reversed the other day when a St. Louis war veteran dug a water well with a post-hole digger on the bank of the Mississippi River and brought in a gas well. Driving down a pipe and capping it with an old inner tube and using the valve as an outlet, he is now cooking with this fuel and using it to heat his home.

A trip through the gas and oil fields will reveal many other houses with small gas wells on the premises. Instead of utilizing the gas, the owner allows it to burn as a torch which gives forth a weird light by night and visible smoke clouds by day. Not so C. B. Mershon of Pittsburgh, Pennsylvania, assistant manager of the Industrial Department, Manufacturers Light & Heat Company.

In Mr. Mershon's backyard is a small gas well and there is considerable pressure back of the gas so that it flows readily. Not only does the Mershon family cook, heat water, and heat their home with this fuel; they do other things with it. The most unusual of these is to mature a vegetable and flower garden long prior to the regular planting season. To accomplish this, a copper pipe is looped back and forth just below the surface of the ground where the seeds are to be planted. This is attached to an ordinary gas-fired water heater. The water is heated to the proper temperature and then circulated through the underground coil. The proper temperature is maintained continuously and automatically by a thermostat. Seeds are planted and quickly sprout under this heat treatment. Of course, they are kept under glass so that the young plants will not be nipped during the cold nights. —*J. B. Nealey.*

Mr. Mershon's backyard gas well

**COPPER**

**THE American nickel contains *three times as much copper as* nickel. Nearly 3,000,000 pounds of copper are used annually in minting U. S. coins, including gold and silver pieces. The familiar penny, or "copper," is really made of bronze, containing 95 percent copper and 5 percent tin and zinc.**

## Unique Office Structure

SOME recent buildings have been designed to achieve bizarre effects, while certain others have turned into oddities largely because of the demands of modern improvements incorporated in the structures. A building of the latter sort, designed by Frank Lloyd Wright, famous for his architectural creations, which will be ready for occupancy this summer, will house the main office of S. C. Johnson & Son, Inc., makers of Johnson's wax polishes.

The plan centers around one large workroom, measuring 210 by 130 feet, to house several hundred employees. Girdling this room, which has a ceiling 20 feet high, is a mezzanine gallery close to the first floor on which are located the offices of department heads and junior executives. Above this hall is a kind of pent-house on the roof, in the shape of three ellipsoidal links, containing the offices of the chief executives.

No windows of the accepted form will pierce the walls of this building, but a band of tubular glass encircles the building six feet above the floor, while a second band follows the rim of the ceiling. There will be no exterior openings in the building except the chambered entrance doors.

Perhaps the oddest features of the building are the two "nostrils" projecting above the pent-house offices. These are circular breathing stacks reaching from the basement to a point well above the roof and con-

stituting a part of the air-conditioning system, which will be of the "true" type—that is, it will be in operation both in summer and in winter.

Of the many other unique features, we might mention that the building is fireproof, 'quake-proof, and sound-proof.

## A Versatile Training Plane

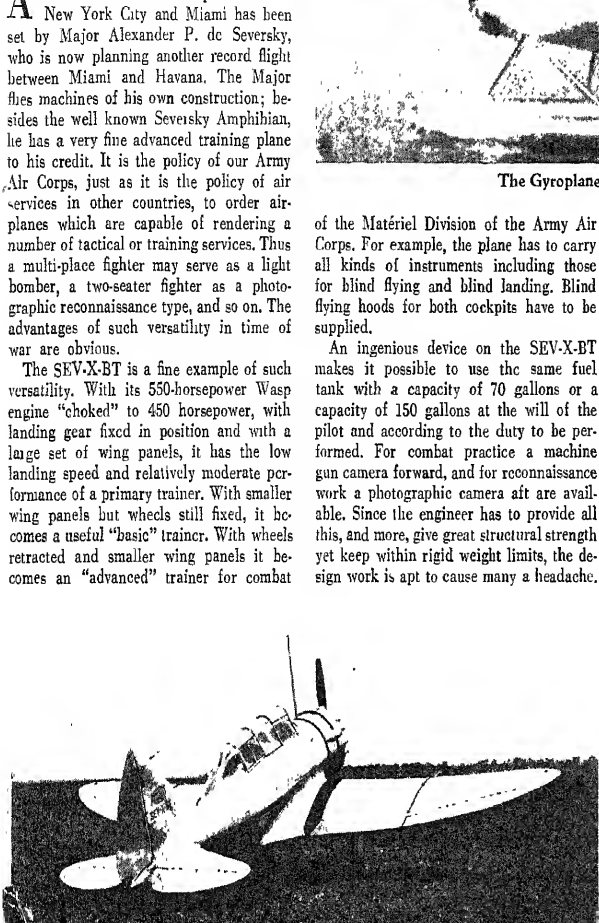
A WORLD'S record for speed between New York City and Miami has been set by Major Alexander P. de Seversky, who is now planning another record flight between Miami and Havana. The Major flies machines of his own construction; besides the well known Seversky Amphibian, he has a very fine advanced training plane to his credit. It is the policy of our Army Air Corps, just as it is the policy of air services in other countries, to order airplanes which are capable of rendering a number of tactical or training services. Thus a multi-place fighter may serve as a light bomber, a two-seater fighter as a photographic reconnaissance type, and so on. The advantages of such versatility in time of war are obvious.

The SEV-X-BT is a fine example of such versatility. With its 550-horsepower Wasp engine "choked" to 450 horsepower, with landing gear fixed in position and with a large set of wing panels, it has the low landing speed and relatively moderate performance of a primary trainer. With smaller wing panels but wheels still fixed, it becomes a useful "basic" trainer. With wheels retracted and smaller wing panels it becomes an "advanced" trainer for combat and tactical work, with the full power of the engine in use. There is great advantage in training Army officers through elementary and advanced stages on a machine having the same general characteristics but with graduation in speed. The fourth classification of the Seversky is as a staff plane for cross-country work. A commodious baggage compartment is included, together with other equipment for long cross-country flights.

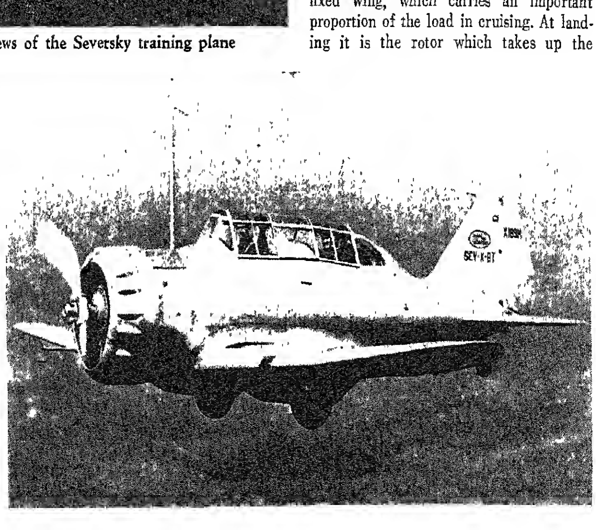
Airplane design is one of the most fascinating of the engineering arts. In military design, the engineer has, however, a large number of things to look after. Thus, in designing the SEV-X-BT, Chief Engineer Kartveli had to provide all-metal construction, multi-box wings, monocoque fuselage, crash protector, and so on, and at the same time take care of an immense number of accessories as specified by various branches of the Matériel Division of the Army Air Corps. For example, the plane has to carry all kinds of instruments including those for blind flying and blind landing. Blind flying hoods for both cockpits have to be supplied.

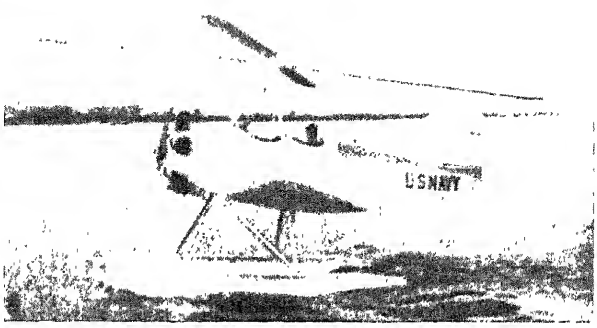
An ingenious device on the SEV-X-BT makes it possible to use the same fuel tank with a capacity of 70 gallons or a capacity of 150 gallons at the will of the pilot and according to the duty to be performed. For combat practice a machine gun camera forward, and for reconnaissance work a photographic camera aft are available. Since the engineer has to provide all this, and more, give great structural strength yet keep within rigid weight limits, the design work is apt to cause many a headache.

The photographs indicate some interesting aerodynamic features. Thus there is a double cowling with two openings so that the air flow over the fuselage is smoothed out as much as possible. Since the rudder is close to the cabin, it is made rather high to retain effectiveness. Flaps are used over the center of the wing. Tail surfaces are built smoothly and integrally with the fuselage.—*A. K.*



*Above and below at right:* Two views of the Seversky training plane



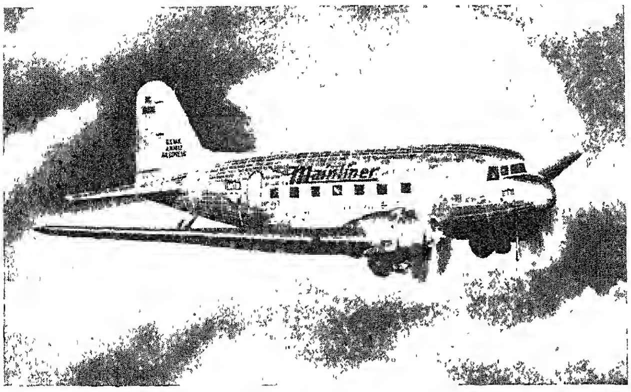




The Gyroplane takes to the water

## Gyroplane on Floats

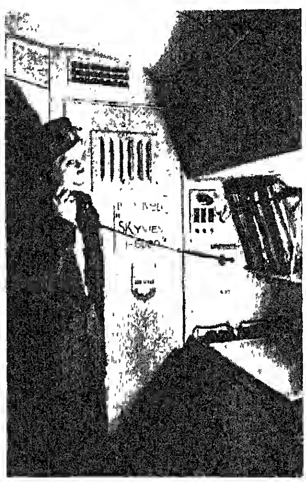
JUST as Harold F. Pitcairn is *the* exponent of the Autogiro in the United States, so E. Burke Wilford of Philadelphia is the leading worker in the Gyroplane field. The Gyroplane is a rotary airfoil craft, in which the blades rotate freely in the windstream, with propulsion effected by the conventional propeller. But instead of the blades being hinged about a horizontal pin and moving up and down, as in the Autogiro, the blades of the Gyroplane are hinged about an axis substantially parallel to the span, and feather or oscillate about this axis.

Now the Gyroplane, for the first time, has been built on two floats. Our photograph shows the XOZ-1 float Gyroplane, which has been built for the Navy Department, and is undergoing tests at the seaplane base at Essington, Pennsylvania. It will be noticed that the Gyroplane is provided with a fixed wing, which carries an important proportion of the load in cruising. At landing it is the rotor which takes up the




Left: The Douglas Mainliner in service on United Air Lines. *Below:* Interior of the plane. *At left below:* A telephone line permits communication between the stewardess' kitchen and the pilots' compartment 30 feet away

major portion of the burden. The specifications of the XOZ-1 are as follows: Rotor diameter, 32 feet; rotor disk area, 800 square feet; span of the fixed wing, 28 feet; fixed wing area, 100 square feet; engine, Kinner R-5 of 155 horsepower; gross weight, 2000 pounds.—*A. K.*



## World's First Extra-Fare Planes

UNITED Air Lines, notable pioneers in American air transport, have now in service the world's first extra-fare planes. The company has recently purchased a fleet of 28 Douglas DC-3 type, twin-engined machines at a total cost of 3,000,000 dollars. Ten of these splendid ships are standard 21-passenger day planes, eight are to be sleepers, and ten "Skylounge Mainliners" have been put into non-stop service between New York and Chicago, with an extra fare of $2.05. The extra fare is no doubt fully justified because instead of seating 21 passengers, the extra-fare ships will provide accommodation for only 14 passengers, which makes a very substantial difference in payload.

One of our photographs shows the very comfortable interior arrangement with swiveling chairs—reminiscent of Pullman practice, but better adapted to the human anatomy. Other cabin features include china, silver, and linen for hot meal service, air-conditioning, steam-heating, soundproofing, intra-plane telephone, and so on.

The Mainliners have also considerable technical interest. They are the first airplanes to put into air-transport service the twin-row, 14-cylinder Wasps which develop 1150 horsepower. American air transport derives many advantages from military and naval aviation developments. The expense of developing new engines of such high power is enormous, but this is taken care of in experimental contracts for the Army and Navy air services, and eventually the more peaceful branches of aviation profit thereby.

It may be asked why constructors and operators always grasp at higher engine power when high speeds are already available? The answer is not only in the insatiable desire for higher speed on the part of the public, but also in the fact that higher engine power adds to safety. With only one engine in commission, the Mainliners can climb to 9500 feet and sustain flight comfortably at this altitude. This means that the transports are immune to the effects of failure of one of the two engines except in certain sections of the Rockies.

The new machines are equipped for multiple radio navigation and have constant-speed propellers, de-icers on wings and propellers, and all other accessories available today. The following is an extract from the latest specifications: high speed, 212 miles per hour; cruising speed, 190 miles per hour; cruising range, 1500 miles without refueling; wing span, 95 feet; length, 64½ feet; gross weight, 12 tons; cabin 27¾ feet long, 6½ feet high, 7¾ feet wide.—*A. K.*

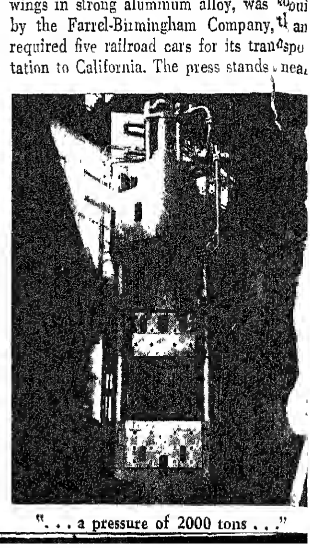
## Synthetic Rubber Balloons

IT would appear that Nazi Germany is not the only country seeking self-sufficiency for war purposes. Our own Army Air Corps is not forgetful of the necessity of *Ersatz* materials to replace those which might conceivably be cut off from the United States in a time of universal upheaval. Rubber is an imported material, and so we read without surprise that the Army Observation Balloon, Type C-3, which is undergoing service tests at Fort Sill, Oklahoma, is constructed of synthetic rubber for the first time in lighter-than-air history.

In making conventional balloon fabric, two plies of fabric—generally cotton—laid at oblique angles are "doubled" or made homogeneous by the interposition of rubber. This method was not changed in the building of the new balloon except that the synthetic product was substituted for natural rubber. Extensive laboratory and exposure-rack tests were made with the new covering. After eight months of testing it was shown that the synthetic compound remained stronger in tension. Also, the gas leakage which is 15 to 19 liters per square meter of surface in 24 hours for ordinary rubberized cloth, was only one to three liters with the synthetic material. Considering the price of helium, gas leakage is often an expensive item. Furthermore, a definite increase in life is expected of the synthetic balloon. It would not be surprising if the *Ersatz* cover replaced natural rubber in all our balloons, war or no war.—*A. K.*

## Giant Press for Aircraft Construction

WHEN Glenn Curtiss, the famous aviation pioneer, built his first airplane he used a hacksaw and hammer as his main equipment—or so the legend runs. For many years airplane construction was mainly a matter of skilled craftsmanship. Today, all metal construction and larger dimensions of the aircraft have brought into play almost every device of the manufacturing or production arts. For example, the Lockheed Aircraft Corporation has recently put into service one of the largest hydraulic presses ever built. The press, which will be used for forming parts of metal fuselages and wings in strong aluminum alloy, was built by the Farrel-Birmingham Company, that required five railroad cars for its transportation to California. The press stands near



". . . a pressure of 2000 tons . . ."

· 26 feet high and weighs 175 tons. With its one 38-inch ram and two 20-inch rams it can exercise a pressure of 2000 tons on the parts to be formed, while the hydraulic pressure in the rams is 2300 pounds per square inch. From the photograph it can be seen what a large clear space is available for operations. The stroke is 36 inches, the closing speed is 130 inches per minute, and the pressing speed is from one to ten inches per minute. The control is remarkably simple. There are hydraulically controlled operating valves, push button for starting or stopping the motor, and two gages to indicate the pressure on the rams.—*A. K.*

## Aeronautical Research

THE Annual Report of the National Advisory Committee for Aeronautics summarizes splendid achievements in aeronautical research and looks forward to even greater activity in the future. Langley Field, the Committee's experimental station, is at present undoubtedly the best equipped aircraft research center in the world. But moving pictures recently exhibited by the Institute of Aeronautical Sciences indicate that Great Britain, France, Italy, and Germany are following our lead energetically and in some respects are even ahead of us. We should not rest too complacently on our laurels!—*A. K.*

**BRASS**

**A MODERN 40-foot motor boat, or cruiser, contains over one million brass screws, mostly in the hull.**

## More Light-Weight Trains

AN order for 52 light-weight, stainless steel passenger cars for the Atchison, Topeka and Santa Fe Railroad was recently announced by the Edward G. Budd Manufacturing Company.

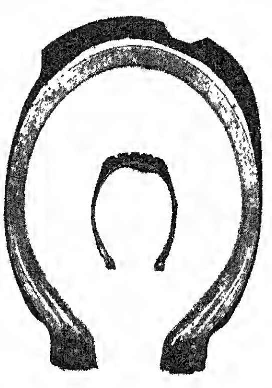
The 52 cars, which will embody the newest designs in railroad passenger equipment, will include 30 passenger coaches, 10 dining cars, six club lounges and six club baggage cars.

This order is in addition to the de luxe nine-car train which the Budd Company now is building for the Santa Fe in its Philadelphia shops. This train will go into service soon as the "Super Chief" of the Santa Fe's Chicago-Los Angeles run, drawn by the powerful Diesel locomotive shown in the photograph on this page.

# TRANSPORTATION SECTION

## Super Tires

TRUCK tires designed for heavy service in the mining and construction fields where motorized equipment is used to move



**A six-inch passenger-car tire compared with a giant "earth mover"**

large quantities of soil and rock, have been announced by The B. F. Goodrich Company.

The large tires, known as "earth movers," will carry a maximum of 15,740 pounds per casing, or nearly eight tons; are mounted on 13-inch rims; weigh 449 pounds; and are available in 12, 16, and 20 plies. The inner tubes for these tires weigh more than 53 pounds and the flaps 12 pounds.

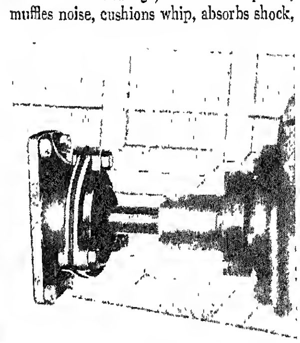
The new tire is now in use on various government projects, including the California All-American Canal, the Mohawk Dam in Ohio, Mississippi flood control, and in several strip-mining enterprises.

Four of the Goodrich tires mounted on one axle will carry 60,000 pounds. The tires may be obtained with two types of tread, one for trailer uses on free moving wheels, and the other incorporating a super-traction tread for use in mud and soft ground.

## Marine Stuffing Box

AN entirely new type of rubber lined stuffing box for motor boat transmissions, free from the maintenance or service problems of rigid or semi-rigid types, and giving greater shaft protection, smoother operation, and requiring no service or attention during the life of the installation, has been announced by the Federal-Mogul Corporation. It is shown in our accompanying illustration.

The Equi-Flex cushion stuffing box, the manufacturer states, is completely flexible, full-floating, self-adjusting, and self-lubricating. It reduces friction, minimizes shift wear and breakage, conserves power, muffles noise, cushions whip, absorbs shock,



**Smoother operation for motor boats**

dampens vibration, and is silent and trouble-free, it is claimed.

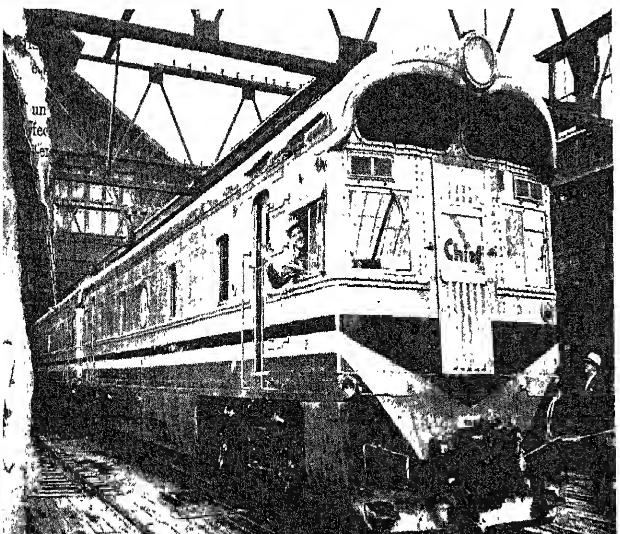
It automatically compensates for all shaft misalignments, accommodates a total of 20 degrees angularity and from $\frac{3}{16}$ to $\frac{3}{8}$ of an inch eccentricity without binding or excessive wear.

The Federal-Mogul Corporation states that the new stuffing box is particularly suited to closely-coupled, flexibly-mounted marine engines, and is interchangeable with all standard inboard stuffing boxes and shaft logs.

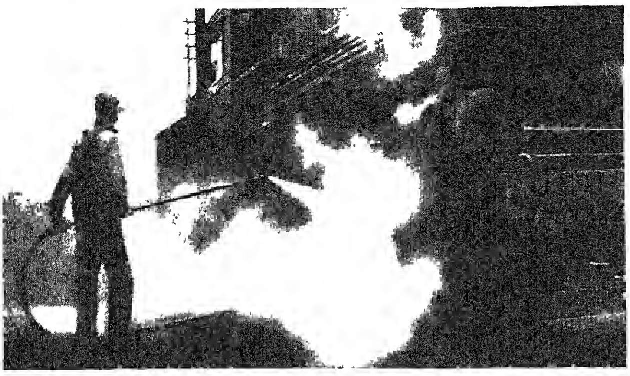
## Five Thousand Crossings Safer

SINCE the summer of 1933, a total of 3125 grade crossings have been constructed or are scheduled for immediate construction with federal funds administered by the Bureau of Public Roads. In addition, standard protection signals have been or will be installed at 1872 crossings.

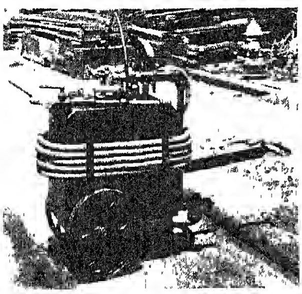
This combined elimination and protection program totals 4997 railroad crossings and



The locomotive for the Santa Fe "Super Chief," newest of the "streamliners"



*Above:* Cleaning a locomotive with a high-pressure jet. *Below:* The cleaning unit in a portable form



does not include an additional number from which travel has been removed by relocating highways. Construction costs, in large measure, have been paid with federal funds, but the states and railroads have provided the rights-of-way and paid other incidental costs.

Bureau traffic experts say these improvements afford daily protection from the hazards of crossings to several millions of people.

## High Pressure Washing

LOCOMOTIVE cleaning must be thorough to permit proper inspection, to facilitate repairs and prevent deterioration. Also, proper cleaning improves locomotive appearance. But—cleaning must be done efficiently and economically.

A device for this work must primarily be flexible, permitting a wide range of water temperatures and pressures and the use of quantities of solvent. Such variations must be instantly and easily obtained for efficient results on varnished surfaces, rough parts, inaccessible parts, and so on. Next, the device must be simple to operate and maintain—durable and economical to use.

The Sellers Hi-Pressure Cleaning Jet meets the above requirements with a compact, inexpensive unit that can be located anywhere that steam and water can be piped.

The heart of the Sellers Hi-Pressure Cleaning Jet is the mixing chamber where steam, water, and solvent are brought together to form a thorough, uniform mixture.

First, water from a water main or overhead tank is admitted to the mixing chamber. Next steam. In this chamber, the steam is condensed, giving up its heat and adding its velocity to the weight of the water, thus producing and maintaining a pressure in the hose of approximately double that of the initial steam pressure. At the same time, condensation of the steam produces a vacuum in the mixing chamber which draws in the solvent from the supply tank below.

It is the condensation and velocity of the fluid in the mixing chamber which causes a violent turbulent action, thus producing a perfect mixture of hot water and solvent. Furthermore, the mixture is maintained through the hose to the work.

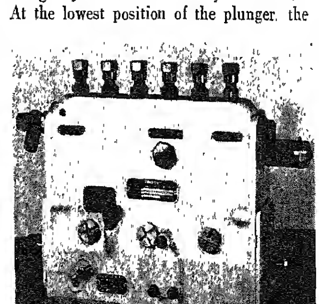
To facilitate economical operation, three convenient gages are provided, indicating at all times the steam pressure, jet pressure, and jet temperature. In addition, an indicating control on the solvent supply permits setting for accurate regulation of the exact amount of solvent for various types of work, and likewise permits instant shutting off of the solvent when desired.

To operate, the workman merely opens the water and steam valves until the desired jet pressure and temperature are reached. Quick visual indication is given by gages in front of the operator. Then the solvent needle valve is opened until the surface being cleaned shows the desired finish. A little experience will permit the operator to establish the correct position of the solvent valve for various classes of work, and he will set it automatically at that point.

## Fuel Injection Pump for Diesel Engines

MEETING the demand for a dependable high-speed, solid-injection fuel pump for Diesel engines, The Timken Roller Bearing Company has just announced two sizes of multiple unit, integral cam-shaft pumps, one using a 4-9 mm range of plunger sizes and the second a 5-11 mm range. At present these pumps are being made for one-, two- and six-cylinder engines.

As will be seen from the accompanying diagrams, these pumps are of the cam-operated, helical plunger type, the metering being adjusted at the factory and sealed. At the lowest position of the plunger, the cylinder receives a charge of oil from the feed line, which is kept filled by a special feed pump connected to the fuel tank. Delivery of the fuel to the engine starts as soon as the piston covers the inlet port and ends when the upper helical edge of the annular groove in the piston opens the overflow or by-pass port on the opposite side of the pump cylinder wall, releasing the pressure to the discharge line. The effective delivery stroke of the piston may be regulated by turning the piston in its cylinder or barrel to vary the point of the delivery stroke in which the overflow port is uncovered.

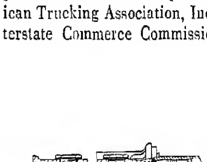


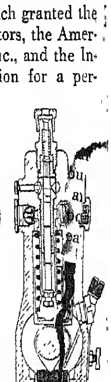
A feature of these Timken pumps is that they are driven by constant velocity cams. Thus the delivery speed of the fuel entering the combustion chamber of the engine is maintained constant at a speed adapted to the rate of combustion, thereby increasing the engine efficiency and fuel economy. The deceleration portion of the motion comes late in the stroke, thus permitting the use of a lighter spring and reducing the spring load between the tappet and the cam.

As these pumps must operate under pressures running as high as 10,000 pounds per square inch, and clearance between the plunger and the bore of the pump barrel is only .000030 of an inch, it is essential that the housing be specially designed to provide the necessary stiffness, for even the slightest deflection would affect the accuracy of the unit.

## Vehicle Weight Law Barred by Court

THE South Carolina law limiting the weight of trucks to 20,000 pounds and their width to 90 inches has been declared by a Federal Court to be an "unreasonable burden" on interstate commerce, insofar as its application to arterial and federal-aid highways is concerned. Local roads and bridges on main roads were not included in the decision of the Court, which granted the petition of motor truck operators, the American Trucking Association, Inc., and the Interstate Commerce Commission for a per-




*Lower left:* New Diesel fuel injection pump. *Above:* Diagrams showing operation detailed in text

manent injunction enjoining the state from enforcing its law.

The Court stated in part:

"Within the past decade there has been a great development of interstate commerce by truck, and a corresponding change and development of industry in the southeastern part of the United States based upon truck transportation. The market gardening industry, the textile industry, the fertilizer industry, and many others have changed in large part their method of doing business as a result of the facilities afforded them by

the use of trucks in interstate commerce. This traffic has developed transportation units of great efficiency designed to carry a maximum load with a minimum of burden or strain to the roads over which they pass. . . .

"A large part of this interstate traffic, with all that it means to the life of the people of the southeastern part of the United States, will be virtually barred from the highways of South Carolina, and a barrier will be erected not merely against the commerce of the state, but also as against the commerce of sister states, if these restrictions are enforced. . . .

"So far as safety is concerned, the evidence shows clearly that there is less danger to traffic from the standard trucks of interstate commerce than from smaller trucks carrying a load for which they are not designed; and certainly there is not enough advantage in a 90- over a 96-inch width to justify the exclusion from an 18- or 20-foot highway of trucks of a width permitted by all other states of the Union."—*Virginia Highway Users Magazine.*

## Sleepy Drivers Often Few Hours on Road

WHENEVER the driver of an automobile falls asleep at the wheel long enough to cause an accident—and that is not very long—he will be lucky if he ever wakes up. A study of driver-asleep accidents in a dozen states reveals that one out of 12 kills somebody, and that one third of the time it is the driver himself.

A surprising fact developed by the National Safety Council and reported by *Science Service,* is that nearly half of the drivers who fell asleep had been driving for less than two hours. A third of these drivers, however, had been without sleep for 16 to 20 hours, so that it is evident that lack of proper amounts of sleep rather than gruelling grinds at the wheel is responsible for a large number of these mishaps. The drowsy driver returning home from a late party is the most common victim of the highway nap, and he usually drops into slumber and oblivion at about two o'clock in the morning.

Pedestrians need not worry too much about slumbering motorists because only 2 percent of fatalities involved the innocent bystander. A case was found, however, of a pedestrian falling asleep himself, with equally fatal results.

Motorists who have a hard time keeping awake at the wheel should get off the road immediately. Otherwise they will have a harder time waking up.

## Why Governed Vehicles?

THERE are now 1,500,000 motor vehicles in the United States equipped with speed governors. It has been thought that governors increase operating costs and retard deliveries, but the experience of the General Electric Company has resulted in a favorable opinion of this method of curbing maximum trucking speeds.

Approximately six years ago, an overnight trucking service was inaugurated between Schenectady and Philadelphia, a distance of 265 miles, with ungoverned high-speed trucks. Heavy trucks were driven at speeds up to 60 miles per hour, creating an accident hazard and shortening vehicle life. Although instructions were given that a speed of 40 miles per hour should not be exceeded, excuses for greater speeds were made on the grounds that lost time had to be made up. Such lost time was found to be the result of numerous stops during the night, which operators knew could be made up by fast driving.

Governors were consequently installed limiting speeds to 40 miles per hour. Maintenance costs have been reduced, and road failures are a thing of the past. Although 90 percent of the 1,600,000 miles traveled have been in hours of darkness, only four minor accidents have occurred, resulting in a cost to the insurance company of 242 dollars. Speed was sacrificed for safety and economy, yet schedules were stabilized and maintained.—*E. I. Hibbard, Transaction National Safety Council.*

**SKID-RESISTANT**

**IN England, paving blocks of iron, rubber, and other materials have been produced with studs of various shapes projecting above the main surface of the block, and it is claimed that a surface of this sort grips the automobile tire like a gear and prevents skidding.**

## Well, Some May Like the Trip

INTERWOVEN for centuries with the history of Paris in its most desperate hours, and immortalized to the world through Victor Hugo's "Les Miserables," the 700 miles of sewers under Paris are a sightseeing novelty for tourists.

This extraordinary underground voyage, made in boats over the black swirling waters flowing far beneath glamorous Paris, is proving of great interest to adventuresome visitors looking for something different. Last summer, 1107 persons undertook the trip which starts at the Place de la Concorde and finishes below the Madeleine Church.

The vast sewers of Paris, one of the great engineering feats of the world, have been visited by comparatively few of the hundreds of thousands of visitors there. Even to Parisians, this is one of the least known of sightseeing trips.

## Pennsylvania Electrification

THE Pennsylvania Railroad now plans completion of the electrification of its lines for both passenger and freight service east of Harrisburg, Pennsylvania. The purpose of this forward step is to promote better service to the public and increase efficiency and economy in operation. The results of the present electrification have been so satisfactory to the company and the public that, in order to secure the fullest measure of benefit, the directors have decided to complete the original electrification program on its eastern lines as announced by the Pennsylvania Railroad in the fall of 1928.

The four-track main line is now electrified between New York and Washington, as are also the commutation lines around

Philadelphia and New York. It will require about 18 months to complete the new work, during the progress of which upwards of 10,000 men will be employed directly on the project and a like number in the industries furnishing materials.

The roadway construction work for the new electrification will be of the same type as that now employed elsewhere in the railroad's eastern electrified territory. It is known as the cross catenary type of construction and is based upon a system of overhead conductors held in place by an arrangement of flexible wires supported between structural steel poles set in concrete beds beyond the outer edges of the track.

The new work will involve the electrification of 315 miles of line and 773 miles of track. Upon its completion, the Pennsylvania Railroad system will have 2677 miles of electrified trackage, or 41 percent of the total electrically operated standard railroad track in the entire United States.

*(End of Transportation Section)*

## Synthetic Resin Insulation

A NEW resin made from polyvinyl chloride has rubber-like properties but is said to be superior to rubber as an insulating material for covering electric wires and cables. It is applied on a conventional rubber tubing machine and requires no curing, as does rubber.—*D. H. K.*

## If You Employ Servants

EXAMINATION of all domestic servants as a means of checking the spread of venereal and other communicable diseases was advocated by Dr. Charles V. Craster, health officer of Newark, New Jersey, at a conference on venereal diseases held by the U. S. Public Health Service.

Such a health examination, which is compulsory in Newark, is aimed at protecting the entire community and not merely families employing domestic servants. Examinations of special groups, such as domestic servants, taxi drivers, beauty shop operators, and barbers are, in Dr. Craster's words, "the spearhead of the attack on the venereal disease problem."

As long as the servant with syphilis is undergoing treatment to make her non-infectious, the family she serves is in no danger, Dr. Craster emphasized. He has found that domestic servants constitute a reservoir of venereal disease, and he suspects other such reservoirs exist in the other groups named.

Among the first 10,000 domestic servants examined in Newark, 1900 cases of venereal diseases were found. Of these 1900, over half—900—were not having any medical treatment at all. There were more cases among itinerant day-workers than among servants who lived in the homes where they were employed.—*Science Service.*

## In Fine Flavor

WHETHER food is eaten for nourishment, or for the sheer pleasure of eating, flavor is the magnetic influence which increases the quantity of food consumed, and favors a sufficient intake for the needs

us, provided experience is heeded and one's better judgment is followed. Certainly, among the lower animals, where experience is relied upon and where convention is almost unknown, flavor is a dependable guide to the selection of suitable food, in proper condition.

Discussing this subject recently, the *Industrial Bulletin* of Arthur D. Little, Inc., says that flavor is of vital importance to all producers and handlers of foods, so that they may be able to deliver satisfactory goods to a flavor-conscious public. There is much uncertainty as to how flavor problems should be handled. Teas and coffees, on receipt in this country, are graded by professional tasters, whose word is final. Many other types of foods are commonly judged by juries or tasting squads. Some people believe that these types of inspection and evaluation should be extended to a wide variety of articles. Others feel that a sufficient guarantee of flavor is the good name of the producer, it being taken for granted that he will not neglect this essential phase of quality. Some producers certainly do not.

There is a general groping for real standards of flavor that may be applied fairly for all. Flavor considerations today may dominate executive action on matters of production, storage, and transportation of foods and beverages. The public appears willing to accept rich natural flavor as proof that the food is right in vitamins, minerals, and other nutritive values. Actually, a packer frequently must select articles of much better than average quality in order to insure the fine appearance and flavor that is now commonplace.

It is widely appreciated that flavor consists of a complex of sensations in which taste and smell predominate. Of these two senses, smell is usually the more important, and, without realizing it, most of us judge food largely by its aroma. The aroma may pervade the atmosphere and bring forth high expectations regarding the food about to be eaten, and serves to advertise occasional foods such as fried clams, doughnuts, or popcorn. It may not be perceived until the food is actually in the mouth, where the warmth and moisture intensify the aroma, so that when it rises into the smelling area above and back of the nose, it is readily sensed. The sense of taste may be reinforced by condiments: sugar for sweetness, vinegar and lemon juice for sourness, and salt for saltiness. Bitterness, though not supplied by ordinary condiments, may be had in relishes, coffee, or beer.

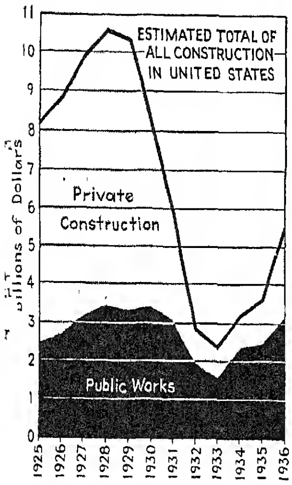
The texture of cereals, desserts, and other prepared foods, and even of natural foods, greatly influences the flavor, through the feel on the tongue or inside the cheeks. While eating walnuts, pecans, or avocado, one becomes very conscious of the value of texture, and also of oiliness. We detect flavor with our eyes also, to some extent. A mint jelly without green is only partly satisfying, and clarity and appropriate color are required in many desserts and beverages.

During the past fall, notable conferences were held in Chicago, New York, and Washington to consider better methods of grading butter, eggs, and other important foodstuffs. Large and small groups worked together to establish useful standards of quality. The American Chemical Society held a symposium on flavor at its spring meeting. The present burst of interest in flavor re-

manufacturers, advertisers, and purveyors to learn about this important yet difficult subject, so that they may be able to keep abreast of the steadily increasing interest in flavor on the part of the American public.

## Public Works or Private

STUDY of the accompanying graph, which is used through the courtesy of *Engineering News-Record*, will show a surprising fact. Much criticism has been generally made of the various public works programs, the intent of such criticism being to show




that there has been an alarming increase; while, on the other hand, much political capital has been made of the fact that the Administration is spending money on public works. Both critics and boasters might as well have saved their breath, if we are to believe the figures here.

Both public works and private construction through 1929 were high and then dropped with the depression. Private construction has not regained its former volume, which is to have been expected. The extraordinary thing is that, despite all the talk pro and con, public works also is still behind 1928, 1929, and 1930. At the end of 1936 the estimate was 3,140,000,000, while in 1928 it was 3,480,000,000; in 1929, 3,263,000,000; and in 1930, 3,363,000,000 dollars.

The answer is that public works are a permanent thing and there is no need for anyone to make political capital of something merely because the public can be so easily deluded.

## Science In Advertising

IN an editorial discussion of the bills before Congress for control of food, drugs and cosmetics, *Industrial and Engineering Chemistry* states that the industries most affected by such improved laws seem "to be actually inviting someone to take charge of the situation, and the facts which science has to offer or could ascertain continue to be ignored in many instances." The editorial decries the exploitation of science in business ballyhoo and cites examples.

"Back in 1934," the article said in part, "an advertisement caught our attention. This was in the field of cosmetics, and, appearing in a reputable publication, we thought we would ask a few questions. Here was an irradiated skin cream which offered the

slowly, gently, safely applying tiny rays to one's skin all night long. It has required some time to reach the end of this story, but we found the manufacturers only too anxious to get to the truth. It now develops that the irradiated cream did give the effect of ultra-violet rays on photographic plates and, in the enthusiasm of that discovery, the advertisement was born but was soon discontinued when a reputable investigator found that, on the evidence of carefully conducted experiments, there was no radiation of any significance and the process was abandoned. That, of course, is to the credit of the manufacturers and no doubt when another idea is brought to them, the lesson having been learned, the investigation will precede, rather than follow, the advertising.

"In the spring of 1936, another cosmetic preparation came to our attention in a full-page advertisement with an illustration in gilt. The attractiveness of gold was evidently being employed, but imagine our surprise to read that this new cream had been blended with pure gold, that science had transformed gold into an astonishing form, soft and pink, that cleanses and revitalizes skin tissue to exquisite loveliness. That, of course, was interesting, but how about this? 'Every atom of this new live gold carries a negative impulse of natural electricity. This negative electricity attracts the positively charged impurities deep in skin pores. Every trace of dirt is drawn away, leaving your skin marvelously fresh and clean.' We had visions of those early experiments with the magnet drawing iron filings around the table and were interested in getting at the truth of this new application of colloidal chemistry.

"After some correspondence, we had analyses made and this cream was found to contain approximately 0.015 percent of gold. Its charge is negative but it is apparently stabilized with soap as a protective colloid. Thus, the gold with the adsorbed soap micelle as a protective coating would be negatively charged and the properties of the gold sol protected by soap would be not those of a gold sol, but those of a soap micelle. It has not been explained to us why the colloidal gold does not react with the ointment base, nor do we know what the magnitude of the electrical charge must be to yank the organic debris out of the pores of the skin, nor just why the embedded debris does not pull the gold in after it, rather than having the reverse phenomenon occur.

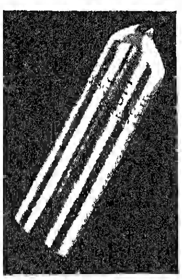
"We are told that some further investigations give reason to believe that the cream we have been discussing may act as a mild skin stimulant, increasing the activity in a way to promote a cleansing action, but that is a very different statement from the published advertisements to which we have referred.

"It is doubtful whether any of the cases we have cited—and there might be many more—deal with preparations that are actually harmful to health, although as is well known, the cosmetic field is not without its examples of horribly toxic preparations. We simply object to the prostitution of science as an aid to obtaining a five dollar bill for a product which, including the jar, may have cost a quarter. We frankly are skeptical that there is any cosmetic preparation, admitting that we have tried none of

young,' 'revitalize withered cells,' 'restore youth to the complexion,' and do those other things that are so much desired in some quarters. Is it not strange how so many can be talked into believing the impossible? It appears to be clearly a case where, if people will not protect themselves from exploitation, the authorities must do the job for them. Far more serious cases might be discussed, but even in this big business of cosmetics common decency demands close adherence to the truth and some effort to produce and supply materials that can be sold on demonstrated merit and backed by scientific data that can be accepted as sound and authoritative."
*—D. H. K.*

## Hardness of Diamond Proved in Industrial Use

THE diamond is generally accepted as the "hardest material known." Just how hard this is in comparison with other substances (hardened tool steel, for example) is seldom realized. The recent production



Diamond pointed boring tool

record of an industrial diamond in use in a Detroit automobile plant provides a dramatic demonstration of this hardness and wearing quality.

The tiny point of an industrial diamond, weighing less than one carat, used in a diamond boring machine in taking the finishing cut on the wrist-pin holes in aluminum alloy pistons, removed a chip or thread of metal 9000 miles long before it required re-pointing! The total length of the hole bored through the pistons, if the pistons were placed side by side, would be 12 miles! This tool removed 926 feet of metal per minute.

This feat is the more impressive because (a surprising fact to most people) this piston alloy is actually more abrasive in character than ferrous metals—iron or steel.

Moreover, the diamond is not worn out even after this period of use. Only its tiny, but extremely accurately shaped point is worn. It requires only re-lapping to the correct radius to prepare it for a similar period of production life.

## "Winter Overcoat" Boosts Cotton Yield

A FIVE-ACRE field near Rome, Georgia, yielded one half bale of cotton per acre in 1932; two bales per acre in 1936. In the intervening years, the owner, J. S. Cutton, planted a cover crop of legumes each winter. The legumes provided a "winter overcoat" for his field, that otherwise would have been exposed to the rains, according to the Soil Conservation Service. They also fixed nitrogen in the soil and made it capable of supporting a heavier growth of cotton. He

its fertility, and conserved moisture. His 1936 cash income from the field was 740 dollars. If his 1932 crop had been sold at 1936 prices, he would have received 185 dollars.

More than a half million acres of cropland in the cotton belt will be covered with legumes throughout the winter months, as a result of the programs of the various state experiment stations, the Soil Conservation Service, and other agencies advocating this practice.

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**SWIMMING**

**AUTHORITIES say that swimming is one of the best reducing exercises while at the same time being a good exercise for building up underweight bodies. This is explained by the fact that swimming tends to develop the body uniformly, so that it works both ways—reducing or increasing weight as the body may require.**

## Protective Wrappings For Fruit

PROTECTING fruit on its way to market by wrapping in paper has long been practiced, and for years it has been sought to impregnate this wrapping with a material which will prevent spoilage by mold. Experiments have shown that iodine (see page 271, May 1936 Scientific American) is useful in this respect were it not for the fact that it may stain the fruit. Diphenyl has been found much more satisfactory for oranges and grapes, which it keeps quite free from mold. The slight odor from diphenyl is not imparted to oranges or grapes, but even the trifling amounts of this compound necessary will injure bananas and apples. Benzoic acid and several of its derivatives, as well as a number of essential oils, have little or no value as shown by experiments conducted in England.—*D. H. K.*

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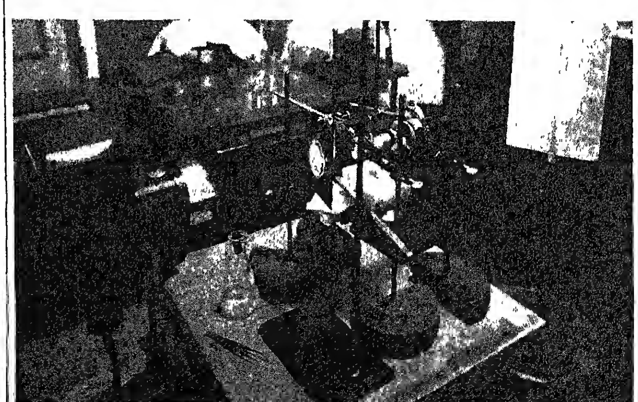
## Insect Heartbeats Basis of Poison Test

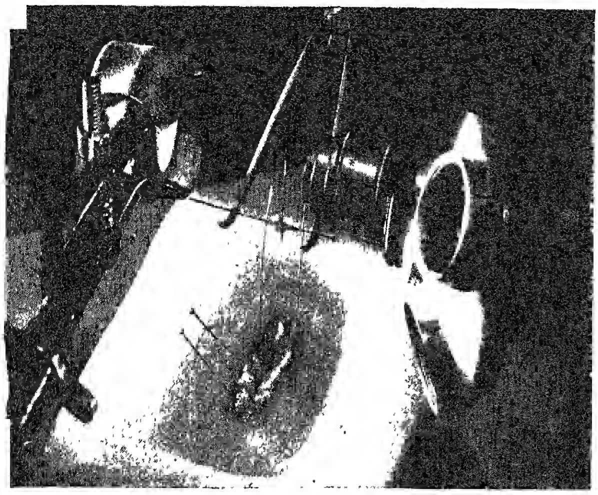
LARGE, clear pictures of insect heartbeats made by a delicate photographic method recently devised by Dr. J. Franklin Yeager, of the United States Department of Agriculture, make it possible to compare the behavior of the heart before and after contact with any one of the substances that look promising in the Department's persevering hunt for better insecticides. The new method also makes it possible to learn more about the way in which the insect heart mechanism operates and to gain physiological information that will be helpful in the search for better ways of controlling insect pests.

Heartbeat records have been obtained from the cockroach, a useful experimental insect that serves the entomologist in somewhat the same way that the white rat or guinea pig serves the zoologist. To obtain a record, the entire back of the insect, with the tiny heart—too small to handle easily alone—attached, is dissected from the anesthetized roach and placed upside down in a beeswax receptacle. The heart tissues are kept alive with a salt solution that acts as artificial blood.

The experimental equipment used is amazingly delicate. With a human hair, attached at one end to the heart and at the other end to a tiny glass lever, every motion of the heartbeat is passed on to the vertical arm of the lever, stained to make it opaque. A strong beam of light turned on the lever passes through the lenses of a powerful microscope and is then projected into the eye, or slit, of a special camera. A moving roll of photographic paper in the camera registers the fluctuations of the greatly magnified shadow cast by the opaque arm, the movements of which correspond exactly with the heart movements. The developed

Adding nicotine to the salt solution which covers an exposed insect heart





Close-up of a roach with its heart exposed for experiments with insecticides

photographic paper forms the heartbeat pictures, or "mechanocardiograms."

Analyses of the mechanocardiograms already made show that, in general, the insect heart contracts, relaxes, and rests, much as does the human heart. Unlike the human heart, however, the insect heart often expands slightly and suddenly just before it contracts. The significance of this "precystolic notch" has not yet been determined.

When nicotine is added to the salt solution, the pictures show that the heart loses its ability to relax. As more and more nicotine is added, the heart relaxes less and less until finally it ceases to relax at all and, in a contracted state, stops beating.

**OYSTER**

FOUR feet by three feet are the dimensions of the biggest oystershell in the world which, in fact, is a fossil recently dug up in the Big Bend National Park area in western Texas.

## Aspirin, Generally Safe, Hits Hard at Sensitive Persons

WHEN a person is sensitive to aspirin, he is violently sensitive to aspirin. And when he isn't, he isn't.

From the Mayo Clinic, Rochester, Minnesota, comes a report of hypersensitivity to this familiar and ordinarily innocuous drug, involving 62 cases. All one of these persons needs to do is to swallow a five-grain aspirin tablet. In from ten minutes to two hours, dreadful things begin to happen. Asthma in an alarming form is the most frequent and serious type of reaction. Other people get terrible sneezing fits and their noses stop up. Some have "giant" hives and others break out into a rash. Some persons' faces swell until their eyes are closed. Others get severe cramps in the abdomen. Still others develop great purple splotches on the skin. Women are more sensitive to the drug than men. Everyone who is upset by aspirin seems to have a personal or family history of allergy. Those with asthma are along with the asthma they have nasal polyps, it goes hard with them indeed. Patients such as these have been known to die following a dose of aspirin.

If an individual knows he is sensitive to aspirin he can avoid it, and he will after one attack of any violence. But the presence of acetylsalicylic acid, its scientific name, in many "patent" medicines makes them an unsuspected source of danger.—*Science Service.*

## Cranberry Emulates Jumping Bean

BEFORE a cranberry is shipped it must prove its vitality and fitness for market by bouncing over a barrier. This is the way the berries are graded. Those that have decayed or otherwise deteriorated will not bounce when they are allowed to drop a short distance. All grading is done by machinery and the berries are given about four chances to bounce over the barrier.

## Aerogel

JELLIES of such typical materials as agar-agar or gelatin are composed of a felt of minute fibers plumped out by water, which is held tenaciously in this fine network by capillary attraction. When a jelly dries down, the felt collapses to a film, but this can usually swell up again to the original volume if soaked in cold water. Several years ago, Professor Kistler of the University of Illinois devised a process whereby the water of a jelly could be displaced by a liquid such as alcohol, leaving the jelly mass in its original volume, and then by converting the alcohol carefully to a gas, leave the felt in the uncollapsed condition. This pithlike form which is called "aerogel" can be secured not only with the jellies noted above, but also from the jellified oxides of silicon, iron, nickel, tin, titanium, aluminum, and other elements. The aerogel of silica under the name of "Santocel" is now available for commercial use, and its producers are seeking practical applications.

Silica aerogel comes as a powdery mass of extreme lightness, soft and compressible. Bulk weights are four to ten pounds per cubic foot. If kept dry, it is a good insulator and has been suggested for Thermos bottles

# THE AMATEUR TELESCOPE MAKER

**Conducted by ALBERT G. INGALLS**

WE give the entire space this month to 20″ Pyrex mirrors and to the "Twenty-Inch Club" of which all automatically become members when working on these new, standard 20″ disks, unless they can give good reason for escape. The first letter is from the Gemini twins, Edward P. Woolcock and W. E. Lester, respectively Sec.-Treas. and Pres. of the Amateur Telescope Makers of Long Beach, 319 Hermosa Ave., Long Beach, Calif.

"IN the March issue of Scientific American you mentioned your hope of hearing from those who are grinding 20″ Pyrex mirrors. Here is our bid for membership in the Twenty-Inch Club.

"We received our solid disk on January 9. The disk weighs about 125 pounds and is slightly over 4″ in thickness. The raw slug had 34 flat sides where the ceramics used in the mould had joined to form as nearly a circle as possible. One side of the disk was marked with grooves, indicating that it was apparently the bottom of the disk when cast. The other side had several large surface bubbles and was far from being flat. Unlike the smaller Pyrex mirrors, which are smooth and transparent, the 20″ disks are more frosty or opalescent and do not have as much amber tint.

"We anticipated lots of labor before we tackled actual work, and our beliefs were well founded. The large disk was a good deal harder than the smaller sizes. Carborundum is a good abrasive for plate glass or even small Pyrex mirrors, but it breaks down too fast when grinding the harder type of Pyrex. We spent many hours trying to face our disk with silicon carbide and aluminum compound abrasives. We had fair success using cast-iron filings. Crushed Steel, however, proved to be the best bet in grinding. It does not break down, cuts four times as fast as Carborundum, makes one tenth the mess, can be used over and over again (one wash and it's as good as new), grooves more than it pits, and above all it is practically as cheap per pound; because it can be used over and over, it is actually much cheaper than any other abrasive for this type of grinding.

"We rigged up a vertical spindle to rotate the disk as it was being ground. An iron plate fastened to the spindle, with three roller bearings to take the weight of the mirror, constituted our grinding machine. With a rotating speed of 30 r.p.m., we used a flat, 12″ cast-iron tool weighing 75 pounds. This tool was used for facing both sides of the disk, and was later turned to curve and used to hog out the center of the mirror. Because the edges were so uneven, we decided to grind the disk to a circular shape and remove the 34 little flat edges. Two parallel, 4″ wooden rollers mounted on a 2 by 4 frame and swung over a rotating, horizontal iron plate, made up our edging machine. [A sketch was submitted but could not be reproduced. The principle is the same as shown in "A.T.M.," fourth edition, page 135—if the separation of the larger disk, and therefore its bearing on the rotating plate, would be variable at will.—*Ed.*] By spinning the mirror over the rollers by hand, and by feeding No. 60 Crushed Steel between the iron plate and the edge of the disk, we were able to true the mirror edge in about five hours.

"We have spent about 15 hours a week working on the mirror. In 6 weeks, or 90 hours, including time for adjustments, tests, experiments, and so on, we have accomplished the following results: The mirror has been faced on both sides, and the edge has been ground into a perfect circle. We have hogged out the center of the mirror, and we are smoothing the curve by hand, using a 1″ thick, full sized plate glass tool and No. 60 Crushed Steel. We tried a marble tool, but it was too soft. Polishing will probably be done by machine and figuring by hand.

Castor and Pollux with mirror

"Let's hear from the rest who are making 20's."

THE two workers having omitted to describe the machine shown in their photograph, we asked for more data and received the following, dated two weeks later:

"We have been working steadily at the job, and we are now just about ready to enter fine grinding. Like all TNs, we changed our minds several times about the focal length. At first we thought we would make it $f/7$, hoping for ease of grinding and figuring. The mounting difficulties of a long focus mirror did not bother us as much as the fact that we wanted an all-purpose mirror if possible—one that could be used for nebular, planetary, and photographic work. We finally decided to make the focal length $f/5$. With this focal length we can get a rich field for studying faint nebulae, a good light for photography and, by using it as a non-perforated Cass, we can have sufficient power for planetary studies.

"You asked for a little more detail on our grinding machine. It is hardly worthy the name of machine. Basically it is only a rotating vertical spindle with an iron plate on top for holding the mirror. The bearball bearings. These bearings are strong and steady and, although they support the weight of the rotating mirror, there is no side play during grinding. A 1/4 h.p. motor with a 3″ V pulley drives a 5″ pulley on a shaft—on this same little shaft (Sears Roebuck polishing support) there is another 3″ V pulley which drives a 14″ pulley mounted on a pipe shaft and supported by 2 by 4 wooden bearings. A 2½″ flat-belt pulley is also mounted on this shaft, and a 2½″ flat belt connects this pulley with a 12″ flat-belt pulley mounted on a 1″ vertical spindle which supports the mirror.

"We have no mechanical device for moving the tool across the mirror. The 2 by 3 braces and many wooden braces which you see slung across the table are merely supports to hold the tool. Our 12″ cast-iron tool has a 1½″ hole in the center. We plugged this with a handle from an old shovel. The handle then stuck up about 10″. A ⅝″ hole was bored through this handle and a steel rod was passed through. This rod served to keep the tool from twisting, yet provided a means for sliding the tool back and forth across the mirror.

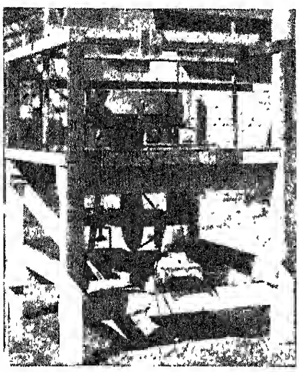
"After having ground the edges with Crushed Steel, as explained in our last letter, we fine-ground the edge with 220 and 280 Carborundum. A piece of thin sheet metal was mounted as a band around part of the mirror's circumference. One end of this tin strip was fastened to a board and the other end was kept taut and snug against the edge by means of a spring. As the mirror rotated, we painted fine Carborundum on the edge. With this simple device we put a fine finish on the mirror's edge in less than one hour. This little time spent on finishing the edge improves the mirror's appearance many times.

"After having roughed out the mirror to an approximate $f/8$ on the machine, we have since been grinding by hand on our plate-glass tool. Using Crushed Steel, we were able to take the focal length down to $f/5$ with comparatively little trouble. At first two of us pushed the glass across the tool, but later we found that it was rather easy for one man to handle the job. So now we each take a ten-minute try at grinding, alternately with a ten-minute rest period. With this method we can grind for a much longer period and with less fatigue. We are having such good success with hand power, in fact, that we may not resort to the machine again, except possibly for some preliminary polishing. The machine, however, was indispensable or almost indispensable when truing the rough blank, edging, and hogging out.

"Incidentally we have taken several feet of motion pictures showing our crude but effective method of attack on the 20″ disk. Someone might be interested in viewing the action."

THE rest of the Twenty-Inch Club appears at present to consist of C. R. Tinsley, 3017 Wheeler St., Berkeley, Calif., whose job we described in the February

Walter L. Moore, Coral Ridge, Ky.; Lew Lojas, 1510 White Plains Road, New York; and Amos H. Huff, Escuela, Ariz., but we don't know at present writing (March 16) how the three last-named of these members are making out. There are probably other workers on 20" Pyrex disks, either the solid variety (less expensive) or the waffle variety (more expensive, being replicas of the 200" disk), but we hope these comments will smoke them out. With these disks purchasable at reduced rates, in clubs of six or more, there is likely to be quite a future development in 20" telescopes and an interesting one at that—especially when it comes to the mountings.



The machine—overgrown spindle

WE sent the two preceding letters to Everest, who returned them with comments on *his* 20" disk—which, by the bye, was given him for Christmas by Mrs. Everest (Wives! Buy your husbands 20" disks, and you will then know they are safe and at home.—Adv.). Everest wrote:

"Been puttering around with the 20". Weighs 115 pounds, less a couple of pounds of bubbles. Hogged her out to an $f/5$ curve, 200" R/C. This meant ¼" deep in the center, and the removal of over three pounds of the hardest glass I ever worked on. Took nine pounds of No. 50 Carbo, ten hours hard labor, and gallons of sweat.

"She was roughed out with a washer tool, which is about four times faster than a glass tool. This is made by cementing large iron washers over the face of a glass tool having the proper radius of curvature. In this case it was a 12½" Pyrex blank which had been used for an $f/8$, 12½" mirror, 200" R/C. The washers wear very little, give the fast action of the channeled cast-iron tool, and can be knocked off for the fine grinding, where glass-to-glass gives slower but much smoother action. There is a little trick to getting them on with a uniform film of pitch. This is accomplished by dropping them into a pan of pitch and bringing them up to almost the boiling point. The tool is cleaned with turpentine, placed face up with the handle down in the milk bottle [See "A.T.M.A.," page 43.—*Ed.*] and the washers hooked out of the hot pitch one at a time and placed in position. If hot enough, most of the pitch runs off and the balance of the surplus is squeezed out by pushing around in ¼" circles until the pitch is nearly set after placing on the tool. This pushing around also gives them a better toe-hold. I always start by putting one in the middle, six around this spaced

"To start the central depression, a circle of washers 8″ in diameter was cemented on the tool, the extra diameter of the glass merely representing useful weight for this spell. 4″ strokes were used until the depression spread to 10″ diameter. When it had reached about 8″ diameter it was found that the depression lacked nearly ½″ of being concentric with the rim of the mirror. So the side that needed it was favored a bit for the remainder of this spell. Didn't worry too much about exact concentricity at this point, however, as the surface was so far out of flat, to start with, that this concentricity was sure to shift a little one way or the other before the depression spread to the rim of the mirror. At 10″ diameter the spit test ["A.T.M.A.," page 26.—*Ed.*] showed the R/C about 10″ too long, showing that the center washers had worn a little faster. This was a natural result of their being the only ones in contact at the start.

"At this point, I made a little experiment I have always wanted to try, in order to determine the difference between Steel grit and Carbo. I never could get any speed out of the Steel on Pyrex without such tremendous pressure, over two pounds per square inch, that astigmatism was sure to be ground in. It always *sounds* as if it were cutting fast, but unless there is pressure enough to get a crushing action on the surface of the glass, not much of anything happens. Steel is not hard enough to get the shearing action of Carbo.

"I tried 2 oz. of Steel grit first and ground for 15 minutes with about 25 pounds' additional pressure. There was no noticeable reduction in size of the grit. Took tool off mirror and left them to dry, after which the grit and gunk were carefully brushed into the scoop of a balance scale. The total weight was 2½ oz., meaning that ⅛ oz. of glass had been removed.

"Same experiment now tried with Carbo: 2 oz. ground down to the point where it was useless for further rough grinding in less than four minutes. On weighing up, however, I found that ⅝ oz. of glass had been removed—more than with the Steel and in one fourth of the time. Several more trials with different pressures gave about the same results with regard to the amount of glass removed, the time taken being in about direct proportion to the pressure. This seemed to indicate that it was going to take three times as much Carbo by weight as glass to be removed, and this was found to be actually the case after the rough grinding was completed. Carbo, of course, was selected for the job, and I used all the pressure possible with my hands at the start, gradually tapering down to 10 or 15 pounds at the finish.

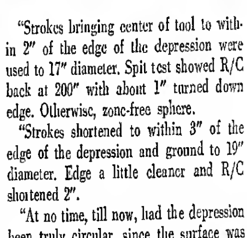
"After the Steel grit experiment, a larger tool was in order but, being suspicious of those center washers, I knocked them all off and replaced with a new set covering the whole face of the 12½″ tool.

"With the washer tool, the mixture of Carbo and water must be exactly right. If too much water, the Carbo will be quickly pushed off over the edge. If not enough water, it will pile up in the center. A few trials when throwing water between tool and mirror to wash out the gunk, will show how much water to leave when sprinkling on fresh abrasive.

"Continuing with the grinding from the 10″ depression, 4″ diametrical strokes were used till it spread to 12″. Spit test showed examination of the tool showed a uniform wearing away of the black oxide from the surface of the washers. There was no danger of the tool getting out of shape from now on.

"The remainder of the rough grinding, the fining, and the preliminary polishing to date have been done with the zigzag stroke shown on page 35, "A.T.M.A.," Fig. 30, left. A job this size must be done on the barrel—as much as I hate it—taking a short step to the left at the completion of each cycle of the strokes shown.

"Zigzag strokes inside about an 8″ circle were used to spread the depression to 15″. R/C shortened 2″.



A. W. Everest

"Strokes bringing center of tool to within 2″ of the edge of the depression were used to 17″ diameter. Spit test showed R/C back at 200″ with about 1″ turned down edge. Otherwise, zone-free sphere.

"Strokes shortened to within 3″ of the edge of the depression and ground to 19″ diameter. Edge a little cleaner and R/C shortened 2″.

"At no time, till now, had the depression been truly circular, since the surface was not flat to start with. So, at this point, a handle was cemented in the middle of a 28″ square of plate glass, and the flat rim of the mirror was ground with No. 240 until it was in contact all over. The local applications of abrasive tried first pushed out from between the two surfaces about as fast as applied. Filling the whole depression with Carbo and water corrected the trouble, allowing the plate glass to pick it up and drag it over where wanted about as fast as required. I didn't time this but it took about 20 minutes, leaving the depression with an exactly circular boundary.

"The depression was spread to the rim of the 21″ disk with strokes to within 2″ of the rim, to prevent shortening the R/C, which it did. But the rough grinding wound up with turned edge plainly visible under the spit test, due to the fact that there is no suction with the washer tool or with such coarse abrasive, and this allows the tool to rock over slightly as it comes nearly to balance over the rim of the mirror with such long strokes.

"The washer tool is not recommended for fining—too harsh action and liability of scratches. So the washers were knocked off and the glass tool was used with the regular sequence of Carbo and fine emery, 1½ hours of each. Although the long strokes were continued, in order to get sufficient abrasion way out, the edge cleaned up during the 280 stage where no turn could be



bubble test [see "A.T.M.A.," page 35.—*Ed.*].

"Well, there is the story of the 20″ to date. Have given her two hours of HCF on the 12½″ tool: surface semi-polished, zone-free, ellipsoid with about 25 percent of full correction. Probably will be most anything else when the preliminary polishing is completed, but I am keeping an eye on her and won't let her get too far out. Requires frequent addition of rouge or water, but nothing like the rapid drying of a full size HCF lap on top of, say, a 10″ mirror."

Everest had not yet edged his disk when he wrote. His photograph, which appears opposite, was taken by one of our special secret service sleuths, E. Dayton Thorne, of Patchogue, Long Island, who snuk up on him one hot summer's day at *Stellafane* with a candid camera disguised as a seidel—note the smile. Since Everest would not furnish his own photograph for the end of his chapter in "A.T.M.A." (which, by the way, is going very well) this is how we circumvent his innate modesty: we suggest that you cut out the picture and paste it on page 48, "A.T.M.A." That, in fact, is why we left that space. With Ellison's loss it seems to us that Everest will now slide into place as the leading mirror expert.

Obviously, Everest and the Lester-Woolcock partnership are in disagreement about the relative virtues of Crushed Steel and Carbo. On seeing Everest's letter the two came back with: "Steel is at least ten times better than Carbo. Of course, you must have plenty of weight on the tool. We used a 75-pound tool and rigged up a lever on which we sat, so that we had about 150 pounds' pressure. Don't worry—the 20″ can take it."

Everest had mentioned above that, with too great a pressure, astigmatism would be ground in; he speaks of 2 pounds per square inch as "tremendous." The pressure used by the other two figures about 1½ pounds. But your scribe is not foolhardy enough to inject any snap opinions into this Battle of the Abrasives; let 10,000 other amateurs make 20″ mirrors, try each kind, and turn in their votes. Woolcock and Lester continue: "When we used Carbo we had to stop very often and clean off the milky residue and replenish the grit. With Steel, however, we merely rubbed a paint brush over the mirror to stir up the particles. We use Diamond Crushed Steel obtained from the Pittsburgh Crushed Steel Co. When you see the grooves that steel makes when used with plenty of pressure, you will give up any other abrasive for rough grinding of Pyrex."

As we go to press the California pair have the final word but maybe, if Everest had it, he would grin and add, "Yes, and when you see the astigmatism. . . ." Or perhaps he wouldn't. It would seem to depend on whether we grant the premise on which the California workers appear to base their argument—that there is no risk of astigmatism.

THIS scribe's face is red, for he omitted a name from the Twenty-Inch Club's list, given earlier. Architect Clarence L. Jones and son Art Jones, of Chattanooga, have been making one, and Marion P. Wall designed the mounting. The job is nearly done. Judging from some newspaper pictures we have seen, this is a swank job. It is to be a community telescope, a labor of

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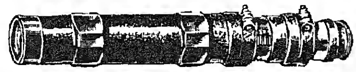

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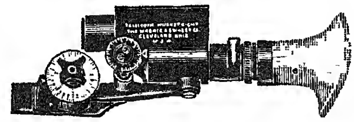

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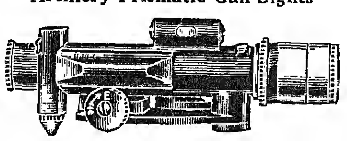

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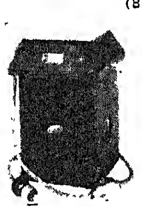

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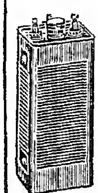

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|---|---|---|---|---|
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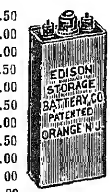
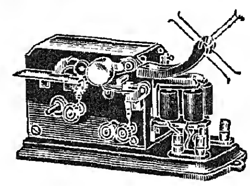
| M-8 | " | 11 | " | 2.00 |




L & M Type



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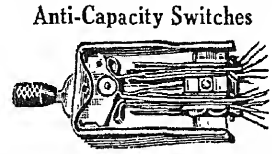

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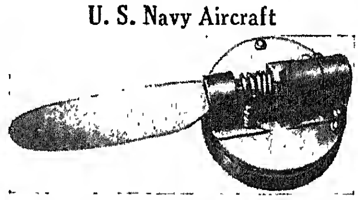

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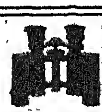

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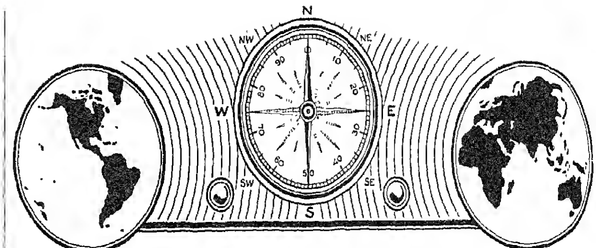



# WORLD-WIDE RADIO

Conducted by M. L. MUHLEMAN

*Editor, All-Wave Radio*

## Coronation and Sunspots

ENGINEERS of the British Broadcasting Corporation are anxious lest what is wrongly called a "sunspot" fade-out should occur during the Coronation broadcasts on May 12th. The chances of such a fade-out during the actual Coronation ceremony are almost negligible, but there was a complete fade-out on December 3rd which affected all daylight transmissions and lasted for half an hour. This was *not* caused by sunspots but by bright hydrogen eruptions which have nothing to do with sunspots.

There is a great increase in solar activity this year, and sunspots are larger and more numerous than usual; but this will not be prejudicial to the reception of the Coronation broadcasts. The BBC engineers have found that the effect of sunspots on nighttime Empire transmissions is generally beneficial. As regards daytime transmissions, the sunspots have less effect, but they, too, are beneficial, and there is only a very remote possibility of bright hydrogen eruptions.

## Italian Short-Wave Center

PLANS for Italy's new Imperial shortwave center, recently approved by the Italian Council of Ministers, include the enlarging of the well-known 2RO, increasing the power of the present two transmitters from 25 to 40 kilowatts, and building two new 100-kilowatt transmitters and a 50-kilowatt reserve transmitter.

Each of the four principal units will be able to work on either of the two wavelengths, each carrying a separate program, while the fifth (reserve) transmitter, will be able to operate anywhere between 14 and 60 meters, either as a substitute for one of the four principal transmitters or as a completely separate experimental station.

The new antenna system, both directional and omni-directional, will include fourteen lattice-work towers, some 240 feet high, while particular care will be given to the beam array for Italian East Africa.

## BBC SOS Messages

DURING 1936 the British Broadcasting Corporation broadcast 1120 SOS and police messages, an increase of 117 over the previous record figures of 1935. There were 765 appeals for relatives in cases of illness, of which 444 were successful. There were also 53 such appeals, of which the results were not known, when all other means of communication have failed. Ordinary police messages (appeals for witnesses of accidents) numbered 301, and of these 145 were successful. There were 36 "special" police messages for missing drugs, and so on, of which nine were successful; and 18 crime appeals with four successes.

In tracing either criminals or missing drugs, radio only plays a part, and it is often difficult to assess its value in a given case. For the purpose of analysis such a message is classified as "unsuccessful."

United States broadcasting stations are seldom used for such purposes, the commercial factor involved precluding the allotment of time to public services. As a consequence, police radio systems have been established to take care of "specialized crime" and the broadcasting of appeals often relegated to the radio amateur.

Occasionally a broadcasting station issues an appeal for information regarding a lost child, but ordinarily such matters are left to the police. In times of emergency, such as the recent floods, our broadcasting stations perform a valuable service by issuing instructions and proclamations to the public, obtaining outside assistance, and handling routine traffic. They are converted from mediums of entertainment into instruments of aid. Their value in the latter aspect is often overlooked.

## Railroad Radio

A NEW type of radio installation has recently been completed on the three sections of Baltimore & Ohio's Diplomat Limited which runs between St. Louis, Washington, and New York. It was especially designed and installed by engineers of the Crosley Radio Corporation to overcome

The antenna that helped solve a re-

certain apparently "dead" radio spots in the Potomac Valley, which had caused previous installations to fail. The receiver has seven tubes and operates on the 32-volt lighting system of the train.

A new and more efficient type of antenna system also had to be provided. Whereas it previously had been impossible to get reception in the Potomac Valley, perfect reception of some 30 stations in that area has been reported under all conditions during daylight hours, the most difficult time for radio reception. The installation includes a standard automobile under-car antenna about three and a half feet long. It is placed horizontally and lengthwise of the car only a few inches above the roof at the lower side, as shown in the accompanying illustration.

## ALL-CONTINENT RADIO-PHONE

SHORTLY after Christmas, and during the early part of this year, radio amateurs operating in the 20-meter phone band set up a new world's record in short-wave communication by establishing an all-continent "party line" encircling the earth. Those who took part were: W4DLH, of Goulds, Florida; HK1Z, Colombia, South America; G5ML, Kenilworth, England; SU1CH, Cairo, Egypt; VU2CQ, Bombay, India; and VK4LO, Brisbane, Australia.

The operators of these six stations stood by in the band on pre-arranged schedule on December 30, 1936. One operator conversed as the other five listened; then the transmission was turned over to the next in line until the entire circuit was completed. In each instance the transmission from one station was clearly heard by the other five.

Similar contacts were made during January, and the time required for completing the "Round Table" has been reduced from 27 minutes to 8 minutes, 10 seconds. The experiment has been so successful that these six operators now "meet on the air" every Tuesday and Friday morning at 7:30 A.M., Eastern Standard Time. Conditions do not always permit the completion of the circuit, but at least some of the stations manage to "break through."

Here is a nice bit of distance reception for the short-wave listener. The next time you are up and about at the hour and days specified, tune your receiver to the 20-meter (14 megacycle) amateur band and see what luck you have. All transmissions are by radiophone.

## FRACTIONAL-WAVE TRANSMITTER

DEVELOPMENT of radio communication at ultra-high frequencies has proceeded with such rapidity that whereas a few years ago the range of frequencies from 30 to 100 megacycles was practically unexplored, today experimental activity extends to much higher frequencies.

Frequencies from 300 to 600 megacycles—corresponding to a wavelength of less than a meter—are now readily generated, and the day is not far distant when these ultra-high frequencies will play an important part in "short-haul" communication.

In the accompanying illustration is shown a recently-developed ultra-high-frequency

Courtesy Western Electric Company

**Six watts can be radiated from this transmitter at a frequency of 500 megacycles—less than one meter**

transmitter capable of producing from 8.5 to 4 watts, respectively, at frequencies from 300 to 600 megacycles. The heart of the transmitter is the new Western Electric "doorknob" tube, so called because of its shape, which makes possible the generation of minute radio waves. It may be seen mounted vertically just above the metal base of the transmitter.

The copper rods, with their ends extended out horizontally like the feelers of some insect, form the antenna system. This aerial is similar in many respects to the "doublet" of much larger proportions used extensively in conjunction with the modern all-wave receiver.

## PROPOSED GOVERNMENT S.-W. STATION

AFTER introducing a bill to establish a government-owned Pan-American short-wave station in Washington, D.C., Representative Celler (Democrat), of New York, outlined a program policy for the United States Commissioner of Education to follow in directing the station.

The station's broadcasts, he said, might be divided into four classes:

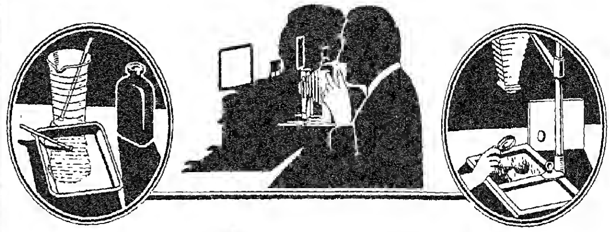
(A). For Pan-American Use: Such as concerts at Pan American Union, important government events as the President's message to Congress, concerts by leading United States musical organizations, and outstanding theatrical productions as those by the Metropolitan Opera Company and the Chicago Civic Opera.

(B). For National and Pan American Service: Addresses by the President and other government officials, and various national events.

(C). For National Service: Broadcasts dealing with aims, functions, and policies of the government, economics and government, home economics, and the like.

(D). For Education: Vocational guidance and programs dealing with the liberal arts, music, drama, the arts, and so on.

The bill has met with opposition—possibly on the grounds that the program policy bears a striking likeness to the policies of a number of the more powerful foreign government-controlled short-wave broadcast stations which, though their intentions may be good, contrive to become involved with propaganda.



# CAMERA ANGLES

Conducted by JACOB DESCHIN

## Dance Photography

RHYTHMIC movement is the chief characteristic of the dance. Arnold Genthe, whose photographs of the dancer Isadora Duncan won him wide fame, appreciated this. Instead of posing his subject in front of a still camera, he hit on the idea of using a motion picture camera and photographing his subject in action. Afterward he selected the best "stills" and made his photographs from them.

The high-speed lenses available today and the facility with which exposures in rapid sequence may be made with the modern "candid" type cameras give the contemporary photographer of the dance somewhat of an "edge" over the photographer of yesterday. An extremely useful camera for this purpose, the Robot, is so constructed that with a single winding of the knob one may shoot 24 exposures without once stopping to rewind. About four or five exposures can be made each second so that it is possible to "stop" the dancer's movements 24 times within as short a period as five or six seconds. Because of the fast movement of the dance, the Robot will be used to best advantage outdoors in daylight, the fastest lens with which it is at present equipped being the Tessar F:2.8. However, the double spotlight often employed in stage lighting for dancing numbers will serve too, provided the action is not too rapid. Moreover, since the recording of a little movement is preferred by many to actual "freezing" of the action, because a sense of motion is thus conveyed, the lack of complete sharpness is not an actual detriment.

The accompanying group of photographs of the young ballet pupil was made with the F:2.8 wide open at 1/50th of a second as it did not seem safe, with a total of but 1500 watts of projection bulb lighting, to give a faster exposure. The 3 cm focal length of the lens, covering a film area one inch square, gave enough depth of field about 12 feet from the subject to permit free movement of the dancer within a relatively wide area.

The worker who attempts dance photography must be prepared to use a lot of film. Not every shot will be a "hit" and quite a few will necessarily have to be discarded after the results are seen in the final negatives. But the good pictures that one will eventually select will be of a type rarely obtainable in a posed photograph.

The tremendous light-admitting power of the F:1.5 lens now available for the Leica and Contax cameras permits exposures, under artificial light, at as fast as 1/500th of a second and faster. Even 1/250th of a second, however, is often sufficient to stop movement. The film used will, of course, always be of the "super" panchromatic va-

*Below and right:* Examples of dance photography with Contax and Leica

nety, the fastest obtainable A few Photoflood bulbs and a good subject, a plentiful supply of film and lots of room to move about in will provide all the requisites for indoor dance photography.

Subjects are not too difficult to get. If there is a budding ballerina in the family one need not go beyond one's home for opportunities. If not, an instructor in stage dancing will be fairly easily persuaded to let you come into the studio when a class is in progress provided you do not create too much of a disturbance. The group here shown, incidentally, was made in a dancing studio, permission having been obtained through a friend of a friend.

## Flash Bulb for Focal Plane Shutters

ESTIMATED to give 50 percent more total illumination than the foil type flash bulbs and to maintain the peak of the flash three times as long, a photoflash bulb called the Superflash has recently been developed and placed on the market. Designed principally to use with professional synchronizers on "candid" cameras of the focal-plane type, the flash element resembles a fine wire fluff, which is really a carefully controlled hydrolanium wire of a precise length and diameter. The timing characteristics and intensity and volume of light are controlled by the precise measures of this wire, the manufacturers announce, so that it has been possible to lengthen the flash at its brightest point, thus assuring full coverage and evenly exposed negatives.

A blue Safety Spot in each Superflash bulb is protection against misses, spoiled negatives and exploding bulbs. The entrance of air into the bulb—the cause of explosions—causes the Safety Spot to turn pink, which means a defective bulb that must be discarded.

## Dry Hypersensitizing

AN increase of from 50 to 150 percent in emulsion sensitivity is claimed to have been obtained by a new method of dry hypersensitizing of film with mercury vapor, the results of experiments by Drs. F. Dersch Laboratories. The film, either wrapped or unwrapped, is placed in a sealed container with a small amount of liquid mercury (0 5 gram) or silver amalgam containing a high percentage of mercury. The film is allowed to stand at room temperature from 36 hours for loose, or unwrapped material, to about a week for wrapped or tightly spooled film. It is further reported that this hypersensitization has no apparent effect on the gradation or the grain size of the photographic material.

The following are some of the facts ascertained by Drs. Dersch and Luerr in their experiments:

"(1). The film does not have to be put through a bathing process and then dried. (2). The increase of sensitivity is general throughout the range of wavelength of light to which the film was originally sensitive. (3). The stability of the film is not permanently affected, although the increase in speed is gradually lost over a period of four weeks of aging. By a second treatment with mercury vapor the hypersensitization can be renewed in a film that has recovered from previous hypersensitizing."

## Using Spiral Tanks

SOME workers occasionally run into difficulties in attempting to insert film into the spiral of the film-processing tanks which have now become so popular—and indispensable. The film seems to start off jubilantly enough but once in a while strikes a snag a little further along the trail. This is because the end of the film strip has been made extra stiff by being attached to the paper leader. You can smooth the path of the film's progress through the reel by cutting off this stiff end or by cutting a diagonal snip from each corner, or do both. For 35-mm film a scheme that has worked successfully is to fold back the film end about an eighth of an inch. The claim is that with this treatment the film will slide in "like butter."

## "Out, Out, D—d Spot!"

WHILE this department is ordinarily immune from metol "poisoning," its hands do not seem to be proof against the staining proclivities of paraphenylene-diamine. Since this is ordinarily used in tanks, we never before had occasion to test our re-

jam in the darkroom, on one of those occasions when things don't run according to Hoyle and it is essential "to get through with it" under the dim illumination of panchromatic green light, we were forced to develop a roll of film in a tray of "P.P.D." solution after pouring the bath from a recalcitrant tank into the tray. It was pretty messy work and our fingers got a thorough soaking in the solution. Nothing seemed to help in our efforts to get rid of the stain so we "let it ride" and allowed nature to take its own course, which it did in the surprisingly short course of a little over a week. Ordinary washing in the regular routine of the daily ablutions constituted the sole "cure."

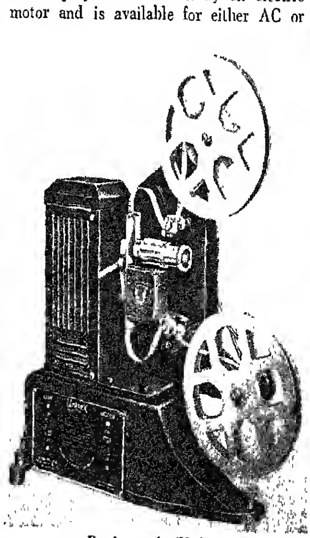
We all know what a boon rubber gloves may be; they certainly would have saved the day in the particular incident recorded above. But, of course, under the circumstances, it was not possible to drop everything and run out for a pair of gloves! In mild cases and if the matter is attended to right away, an application of Edwal's Stain-Go might help, as well as a thorough scrubbing with soap and water.

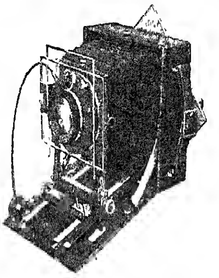
## Movies at Low Cost

UNDOUBTEDLY one of the reasons why more photography fans have not gone in for motion picture work is the high cost of equipment and film. This department knows only too well how *family* budgets are pared in order to provide the wherewithal to fit the desires of the average "still" photographic bug. Thus, when consideration is given to movie work, the decision usually is in the negative (no pun). Now, however, it is possible to procure a thoroughly satisfactory little 8 mm camera *and* projector for less than 30 dollars, and to shoot motion pictures to your heart's content for a relatively low cost per minute of projection time.

The new camera is known as the Univex 8 mm Cine Camera and is a beautiful job of workmanship, particularly when cost is taken into consideration. The camera is available with any one of four lenses—F:5.6, F:3.5, F:1.5, and a telephoto lens. Standard equipment is the F:5.6 lens and the others can be had as accessories. Even for the fastest lens the price is low.

The projector is driven by an electric motor and is available for either AC or







Univex 8 mm Cine Camera in use

AC-DC operation. It can accommodate a standard 200 foot reel of 8 mm film giving a projection time of approximately fifteen minutes. Two switches are provided, one for the motor and the other for the light—which incidentally is a special concentrated filament projection lamp. An automatically operating screen is provided so that stills can be projected without danger of scorching the film.

Small enough to be carried in the coat pocket, the camera is inclosed in a die-cast case, adequately light-trapped. The spring motor will operate for approximately 20 seconds at a sustained speed, amply long enough for the average motion picture scene. A footage indicator tells how many feet of film are left unexposed.

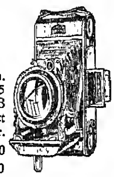
Whether it is used as an accessory to the still camera or serves as the basis for a start in the amateur movie hobby, this new camera with its accompanying projector will give entirely satisfactory results, particularly when the low drain on the pocketbook is considered.

## ROLLEIFLEX EXHIBITION

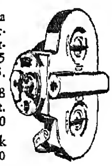
AN opportunity for users of the Rolleiflex, Rolleicord, Heidoscope, and Rolleidoscope cameras to exhibit their pictures and possibly win a prize is offered by Burleigh Brooks, Inc., 127 West 42nd Street, New York City, who has announced an exhibition to be held in a suitable place in New York, not yet announced, sometime in May. Cash awards for the most outstanding photographs submitted will be made in each of four classes: Pictorial, Portrait, Technical, and News. The first prize in each class will be 50 dollars, the second, 25 dollars, and there will be 25 Honorable Mention certificates. A Grand Prize of 100 dollars will be awarded to one of the four winners of the first prizes.

The rules are that no more than four prints may be entered by one exhibitor and prints may not be smaller than 8 by 8 inches, the desired size being 11 by 14 on 16 by 20 mounts, white or cream-colored. The last day on which prints may be submitted is May 7, 1937. Each print must have on its back the following data: Camera used, film,







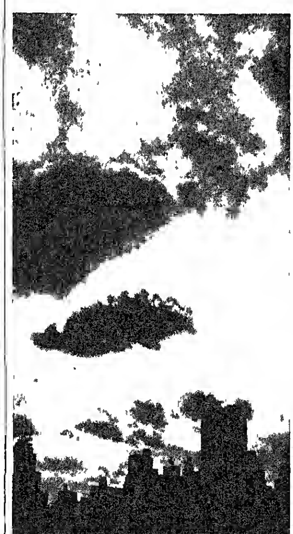


design of the case is illuminating and gives an inkling of the thoroughness with which manufacturers of photographic equipment usually work in order to bring out a completely practical article of real use to the amateur. Here it is:

"We went to the best cabinet maker we knew and had a wooden case made but decided it was too bulky and too heavy. Next we tried standard hard fiber board and made a case that looked promising but when it went through the mails, the walls collapsed. One after another we had ten models made by four craftsmen in different lines. We tried thin fiber sheets but they proved too flexible; we reinforced those with rigid boards but that was not quite right either. We tried an all-metal case, then one having rigid fiber top and bottom with attached metal walls but when that went through the mails, the sides were badly dented. With the tenth model, we have reached the answer. It is a case made of strong fiber pressed specially thin for us by the mill to achieve light weight and it has rigid top and bottom with solid fiber walls that are incased in folded and riveted duralumin."

## CLOUDS IN THE CITY

IT is not without reason that the photographer is attracted to clouds and never misses an opportunity to snap them. In the city he finds many interesting compositions



Skyline and clouds

which would be worthless without clouds. Buildings silhouetted against the sky are a favorite subject; trees and clouds are another. Clouds are restful, inspiring, beautiful, and gay. They may also be somber, dramatic. The yellow filter has been used for a long time to cut down the intense influence of the blue of the sky on the film and so give the clouds a chance to record themselves in proper contrast, but in recent years a number of new filters have been introduced for the express purpose of obtaining a dark sky in which the blue is not only cut down but cut down to a quite dark gray. The most popular of these at the present time is the light red filter which must, of course, be used in conjunction with panchromatic film. Also, the exposure must be increased

## THE SCIENTIFIC AMERICAN DIGEST

*(Continued from page 329)*

household refrigerators, and ice cream cabinets. It is also suggested as a bulker, especially for alkali powders, for the silica is readily soluble in alkaline solutions. Such ready solubility provides a means for preparing the silicates of organic bases.

Aerogel possesses the remarkable property of mixing rapidly and uniformly with pigments. When a tube containing a considerable bulk of aerogel and a small proportion of colored pigment is shaken once or twice, a uniform mixture is obtained. This provides a most spectacular demonstration of its exceptional dispersive properties which may find practical application in paints and lacquers.

A number of interesting uses follow from the remarkable behavior of aerogel with liquids. Certain grades are said to absorb up to 80 percent of their volume of water without getting "wet." After that, a paste is formed. Aerogel is thus of value in drying up watery liquid compositions. It may also be used in making thick greases from thin oils, and has been suggested as a suspending aid for the pigments in paints and printing inks.—*Industrial Bulletin* of Arthur D. Little, Inc.

### 'Bulb-Within-a-Bulb' Mercury Lamp

DEVELOPMENT of a unique 100-watt mercury lamp, a relatively small tubular "bulb within a bulb" that is expected to accelerate lighting progress materially and bring substantial benefits in commerce, in industry, and to such specialized fields as street lighting and photography, was announced recently by the Mazda lamp manufacturers at Nela Park laboratories.

Although the new lamp is still in the experimental stage, laboratory experts were enthusiastic concerning its potentialities. They declined, however, to predict just when the double-bulb specimen would be made commercially available.

In its present stage, the strange lamp produces 30 lumens per watt, or about as much light as the standard filament 200-watt lamp now emits. Early tests indicate that this experimental mercury lighting tool not only has a relatively long life but maintains a remarkably high light-output as well.

About the size of a small cucumber—the outer bulb has a diameter of 1½ inches and an all-over length of less than six inches—the new lamp is less than half as wide as the standard 200-watt tungsten filament lamp and measures two inches less in length. This compactness, plus other efficiency advantages, experts explained, indicate that this bulb-in-bulb mercury lamp will, when perfected, adequately answer urgent needs for a mercury lamp which can be used satisfactorily in combination with filament lamps to give a better quality of light from reasonably small lighting units.

The outer bulb of the new 100-watt mercury lamp consists of a tubular-shaped protecting envelope of soft glass. The inner bulb, also tubular, but about the size of a stubby fat thumb, is made of extra-hard heat-resisting glass. This "bulb" or "thumb" is only two inches long and about an inch in diameter. Within is a small amount of mercury and enough argon gas to "start" the lamp.

Unlike the present 250 and 400-watt mercury lamps, this bulb-in-bulb small edition operates from either a 110-115 or 120-volt line without need of a voltage step-up for starting. A reactor or "choke" governing device is, of course, required to keep the lamp

The latest in mercury lamps

from "racing away with itself" while in operation. It operates at about two atmospheres pressure.

When the new lamp is first turned on an arc strikes. This emits a feeble bluish glow. The lamp takes about five minutes to get fully "warmed up." Meanwhile, the glow gradually builds up into an extremely brilliant stream of light.

If used for street lighting, this new lamp would require a transformer to insure proper voltage and current for satisfactory operation.

### Behold the Mighty (Midget) Dinosaur

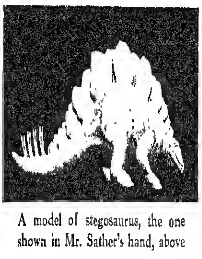
SCULPTOR Jack Sather of Fort Peck, Montana, is shown in our illustration putting the finishing touches on a clay model of Stegosaurus, a dinosaur of the Jurassic Period of about 150 million years ago. Stegosaurus is one of the oddest creatures that ever lived and, for his size, had the smallest brain known. He measured 11 feet high and 30 feet long. His fossil remains are found in the territory immediately east of the Rocky Mountains.

In the background are other dinosaur models by the same artist together with a portion of the famous Fort Peck Fossil Collection. The territory near the great dam, now under construction by the U. S. Army Engineers, abounds in fossil remains of dinosaurs and other reptiles. The collection was assembled by workers on the dam and residents of the area. Since the reservoir to be created by the dam will cover 245,000 acres, plans are being made to conduct an intensive search for fossils in the area before it is flooded. Several eastern institutions are particularly interested.

Mr. Sather has been sculpturing for years. While in college, he became interested in dinosaurs. Now he devotes about all of his spare time to their study, particularly in Professor Marsh's "Dinosaurs of North



Sculptor Sather's models, accurate to the tiniest detail



A model of stegosaurus, the one shown in Mr. Sather's hand, above

tiniest detail so far as known. Best of all, he can spend his Sunday afternoons in the badlands near Fort Peck and find hoofs, claws, skin-plates, horns, and bones of the creatures he delights in reproducing. He expects to have an entire exhibit case filled with models before spring. Each shelf will represent a different era, beginning with the Jurassic and ending with the uppermost of the dinosaur zones in the Cretaceous. Each group will have a painted background depicting its associated flora and contemporaneous fauna.

### Hayfever from Civilization's By-Product

THOSE unfortunate persons who must sneeze and snuffle their way through every summer and fall, unless medical treatment or vacation resorts can give them relief from hayfever, are paying the price of civilization. This view of a miserable ailment was recently presented by R. P. Wodehouse, scientific director of the Arlington Chemical Company, to members of the American Institute of New York City.

An enormous increase in ragweed and certain other hayfever-causing plants is a by-product of our modern civilization which has disturbed the soil and its natural balance of vegetation, Dr. Wodehouse pointed out. Ragweed plants were scarce before civilization came along to plow up large sections of land, dig ditches for sewers, level off stretches for roads, and otherwise disturb the vegetation.

The hayfever patient and others who suffer from allergies are not invariably abnormal, Dr. Wodehouse suggested. It is their environment which is abnormal. Dr. Wodehouse said that allergy is seldom evident with respect to those things old in the experience of the human race. Pine trees, he pointed out, produce far greater quantities of pollen than ragweed, yet no one seems to get hayfever from pine pollen. "The human race," he said, "must certainly have been cradled in an atmosphere of pine pollen and has ever since been subjected to annual exposure to it. We are all immune to pine pollen and to a certain extent to the pollen of most of our deciduous forest trees." Civilization has made a ragweed paradise of this continent, Dr. Wodehouse maintains, and the "end is not yet in sight for the ragweeds are still on the increase as more and more areas are laid open to them."—*Science Service.*

### TOPSOIL

**IN addition to an enormous destruction of property, the January-February floods in the Ohio Valley carried away an estimated total of 300 million tons of topsoil. This loss is irreplaceable and rich farming lands have suffered accordingly.**

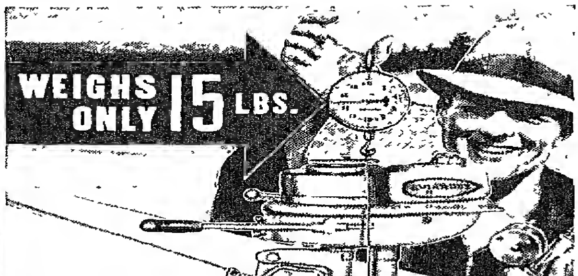
### Glycerol As a Drying Agent

ALTHOUGH glycerol prices in the United States have been rising as new uses for this by-product of soap manufacture have been developed, word comes from England of its economical use to remove moisture from manufactured gas. Glycerol readily absorbs moisture from the gas before it is put into the mains. After absorbing moisture to its limit the glycerol is re-concentrated and used again. The cost is very low because the glycerol can be completely recovered. It is preferred to other drying agents which are corrosive to equipment and may react chemically with the constituents of the gas. —*D. H. K.*

### Seaweeds Made Many Rocks

SEAWEEDS are responsible for the formation of many massive rocks in the older strata of North America, the Paleontological Society was told at a recent meeting by Dr. Carroll Lane Fenton and Mrs. Mildred Adams Fenton, *Science Service* reports.

Many seaweeds even today are great gatherers of limestone, which they extract from

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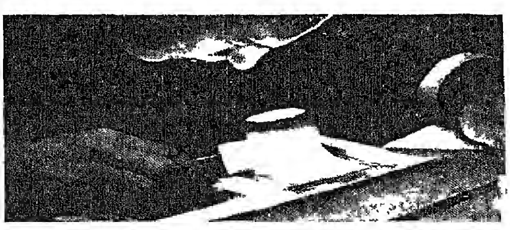
## New Illuminated Magnifier

Professional men, police departments, stamp collectors, bankers, purchasing agents, textile men,



mechanics, agriculturalists and manufacturers of all products requiring close surface inspection have found use for this new illuminated magnifying glass. Giving powerful magnification with illumination of the field of vision, the new "Flash-O-Lens" employs a double lens system.

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about themselves. Some seaweeds of this type are often superficially so like corals that many persons mistake them for these animals.

It is difficult to identify some of these seaweed-deposited limestones, Dr. Fenton said, because they form a maximum of lime and leave a minimum of plant traces. Nevertheless, he and Mrs. Fenton have been able to make out certain form-species that appear to be alike in widely separated regions, such as the Grand Canyon, Minnesota, Montana, and Pennsylvania.

Worms, also, can slowly build mighty rocks. Drs. B. F. Howell and John F. Mason of Princeton University described reefs in certain California strata, formed entirely of the limy tubes in which, ages ago, lived crowds of the marine worms known to science as *Serpula.*

## Transparent Utility Boxes

Boxes of transparent resins, particularly cellulose acetate, are finding a ready use as packages for everything from orchids to shirts, hats, and shoes. By providing transparent containers in which a traveler's clothing can be kept in order on a long journey, or in which accessories to milady's apparel can be put away out of the dust but easily identified when needed, these new plastic products are finding great favor. Some retail stores, recognizing the added sales appeal of articles packaged in these relatively cheap containers, supply them gratis with purchases.—*D. H. K.*

## Your Brain Keeps on Growing

A mentally active human brain keeps on growing until the age of 50 or 60. This is the most logical interpretation, says Dr. Ales Hrdlicka, curator of physical anthropology of the Smithsonian Institution, of a slight but constant increase in the dimensions of the head which continues in mentally active men and women throughout most of adult life until the changes associated with old age begin.

The increase in head size has been found by Dr. Hrdlicka in measurements made on "old Americans"—persons with at least three generations of American ancestry; on the members of the National Academy of Sciences; and even on a large group of Indians. It has just been demonstrated strikingly by reported measurements of large groups of Russians of various racial groups, and it appears in the great body of data collected by French anthropologists.

"There is no evidence," Dr. Hrdlicka says, "that either the scalp or the bones of the vault thicken with age; the scalp, in fact, it is now known definitely, becomes thinner."

## Latex Storage Battery Separators

Failure of storage batteries in use has frequently been caused by damage to the non-conducting separators placed between the battery plates. A new type of separator made by vulcanizing rubber latex has been found far superior to the separators generally used. The cured latex sheets resist the chemical action of the acid in the battery ... discharging it through as many as 24,000 cycles of charge and discharge. Cedar separators fail before 12,000 cycles have been reached. The natural porosity of the latex separators introduces less internal resistance into the battery than wood separators. —*D. H. K.*

## Windmills Come Back—As Protectors

The eerie squeak of the windmill, once quixotically annihilated by gasoline power, has returned to haunt the home of its successor. Windmills are being used to protect vast pipe line networks from corrosion.

Thousands of miles of underground steel pipe carry crude oil, stabilized crude, refined products and gas. Conditions are ideal for corrosion, with heavy leakage and maintenance costs, for when steel is thus buried underground small electrical currents are set up on which the metal floats away. Technically it is electrolytic corrosion, with the steel pipe the anode from which iron ions go off into the soil. One ampere of current will carry away 20 pounds of steel per year, and, as this loss usually comes from small local areas, the corrosion problem is serious.

By the simple procedure of reversing the current by impressing a small voltage from an outside source, this electrolytic corrosion is stopped, the pipe becomes the receiving end—the cathode—and is protected by a layer of hydrogen formed at that point.

The practice of this new method may be applicable to other situations where steel is buried in moist earth. A hole is dug near the pipe line and scrap iron dumped in. Sometimes rock salt is added to make the ground more conducting. The pile of scrap iron is connected with the positive pole of a source of low-voltage direct current, and the negative pole is connected with the pipe line, usually in a number of scattered places. Through the circuit thus formed, current flows from the positive pole of the source of electricity through a copper cable to the scrap iron, the anode, which corrodes rapidly but is of negligible value. The current then flows through the earth, the ions being carried by the moisture in the soil, to the pipe line, now the cathode, and a protective film of hydrogen forms on it. The current then returns to the source by another copper cable.

Any source of electric power may be used for this "cathodic protection," but the commonest are probably small low-voltage generators driven by windmills. In the pipe line country of Texas and adjoining states the winds are steady and reliable, and the almost obsolete windmill again becomes a familiar mark on the landscape.—*Industrial Bulletin* of Arthur D. Little, Inc.

## Frozen Smells

Measurement of smells by freezing them has opened the way to a new method of filtering odors from re-circulated conditioned air in railroad cars, V. A. Gant of the University of Illinois Medical School and H. D. Shaw, research scientist of the Pullman Company, report to the American Chemical Society.

Conducting tests in a lounge car where passengers were eating, drinking, smoking, and sleeping, the investigators found that

tioned air, composed of 25 percent fresh air and 75 percent re-circulated air, became objectionably odorous.

"Large proportions of tobacco smoke, and the odors of food, liquor, and human bodies from the bedrooms and the lounge were drawn directly into the re-circulated air intake," the report points out.

The problem was to measure the smells individually, so that an efficient filter could be designed to eliminate them, and this was accomplished by filtering the air from the car through dry ice.

"The frozen odor and moisture were placed in a wide mouthed bottle properly fitted with a cork collar through which was inserted an osmoscope," the report continues. "An osmoscope is an instrument permitting the measurement of smells by measuring the concentration of fresh air at the time the smell becomes apparent to the technician."

Once the smells had been measured, Gant and Shaw point out, it was necessary to devise a filter which would remove them without itself exuding any odor, as chemical filters were found to do. The best medium for this purpose, the scientists discovered, was activated carbon. The filter devised was constructed on a principle similar to that of the first gas masks used in the World War, which contained a filter of nut shell carbon. Subsequent tests established that the carbon filters were successful in removing any noticeable trace of odor in the lounge car used in the first experiments, and that the filters have an effective life of at least four months.

**GLASS FIBERS**

**DEPENDING on the nature of the application, glass fibers vary in diameter from 0.02 inch to 0.0002 inch (less than the diameter of human hair) while some fibers for special purposes have been produced as fine as 0.00005 inch.**

## Social Service and the Weaklings

IN a long letter to the *Times* (London) Lord Dawson has gone to the root of the problem of national health in its politico-medical aspects. He points out that years ago nature's method of selecting the fit was a high birth rate and high infant and adult death rates. Formerly weaklings in body and mind sank to a low economic level, lived precariously, and were prone to elimination by diseases such as tuberculosis. Today, through our social services, they receive maintenance and increasing protection from the ravages of disease. The mortality from tuberculosis has been halved in the last 25 years. Further, these weaklings often propagate to the disadvantage of the race. This nugatory rendering of nature's rough method of elimination necessitates an alternative policy, which we have not thought out. It should comprise (1) plans to promote fitness during the period of rearing and development; (2) plans to secure that the most fit among youth, from wherever they derive, have every opportunity to get to the forefront; and (3) plans of special and kindly measures for dealing with the inherently unfit. kind to the weaker brethren of today we are not more than unkind to all the brethren of tomorrow. It is relevant to consider the birth rate. During the 50 years 1880-1930 there was a decline in the crude birth rate of 54 percent in England. The dominant cause is contraception, which is widely and increasingly practiced in all European countries. Its practice is more prominent among the more educated classes, but it has already reached the artisan class and is rapidly penetrating the classes that live by unskilled labor. One potent cause is the fall of the infant death rate from 172 to 57 per thousand births during the last 90 years. Formerly the death rate was the safety valve. But contraception can be misused and in some cases families are too small. Fit citizens should more than replenish their own places.

Finally, the inherently unfit should be actively discouraged from reproduction. Good nurture cannot be a makeweight against bad breeding.—*Journal of the American Medical Association.*

## Dyeing Molded Plastics

A NEW method of dyeing articles molded from synthetic resins allows manufacturers to apply colors as desired to their product without requiring them to hold large stocks of various colors. In the past the manufacturer of colored articles from synthetic resins has been compelled to introduce the color into the molding compound before finishing. The new process, developed by Gustavus J. Esselen, Boston chemical consultant, involves softening of the surface of the molded article in a solution containing glycerin and a phenol. This softening process allows dye actually to enter the molded article and give it a depth of color. An advantage of the process, which may be applied to plastics containing a variety of synthetic resins, is that it allows manufacturers to stock uncolored molded pieces and to dye them in colors demanded by changing fashions.—*D. H. K.*

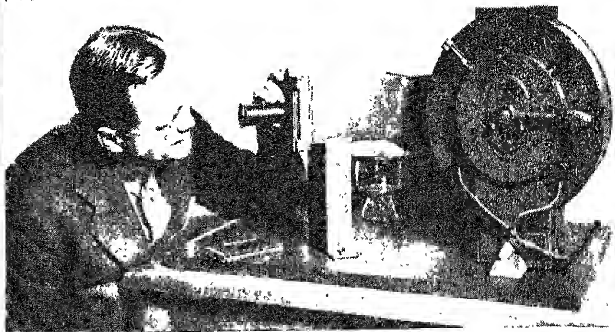
## Mill-Impregnator-Truck Makes Stock Feed

DURING the western drought, it was discovered that a remarkably fine stock food could be obtained by mixing almost any food the farmer had—beet pulp, oats, corn, and so on, with black-strap molasses. This addition converts feed that is short in carbohydrates and long on bulk into a tasty, rich, appetizing product of much higher value.

However, the processing necessitated a long trip to the mill, and another complicated operation to impregnate the ground feed with molasses. But today farmers near Lapeer, Michigan, do not have to worry about these costly operations, for their mill now comes regularly to their own barnyard, every two weeks.

This ingenious and practical outfit consists of a portable mill and a molasses impregnator mounted on a Diamond T truck. The truck motor, through a specially built split shaft power take-off, furnishes the power.

The farmer has his feed ready when the truck is due, the feed is ground and impreg-



Equipment for rendering fingerprints visible by ultra-violet light

and the truck then departs to the next farm on its schedule. The farmer is left with ample high-grade prepared feed, ready for instant use, without the expense and time of hauling—a remarkable instance of the mountain not only coming to Mohammed, but making a tidy profit in doing so!

## Oat Flour Prevents Rancidity

RANCIDITY in foodstuffs is known to be caused by the action of oxygen on fats and other compounds in them. To overcome oxidation, a number of synthetic chemicals have been found effective, but most of these are of such character that they cannot be added to foodstuffs. Recently it has been found that oat flour possesses to a remarkable degree the power to suppress the changes in foodstuffs which result in rancidity. The oat flour may be mixed directly with the fat or other foodstuff, or may be used to treat the wrapping material of the food package. A small amount of oat flour (1 to 5 percent) incorporated into a surface coating on paper has been found effective. Treated paper has been used successfully for wrapping butter, lard, bacon, cereal products, potato chips, salted nuts, and coffee, among others.—*D. H. K.*

## Invisible Light Makes Fingerprints Visible

A NEW tool for crime detection was described recently by Dr. Francis F. Lucas of East Orange, New Jersey, as one outcome of his years of work in the field of photomicroscopy. Noting that the fatty deposit which constitutes a fingerprint does not always catch and hold the fine powder which is dusted over it to make it visible, Dr. Lucas cast about for some other way of making the imprint visible.

In his contacts with biologists, Dr. Lucas learned many of their experimental methods, one of which is to "fix" a fatty substance by exposing it to the fumes of certain chemicals known as Fleming's reagent. This should make a fingerprint insoluble, reasoned Dr. Lucas, and then if the print were on paper, the paper with its fixed print could be dipped in a dye which glows brightly under ultra-violet light. This phenomenon, known as fluorescence, is one which Dr. Lucas regularly makes use of in his high-power microscope study of metals at Bell Telephone Laboratories. Experiments showed that he was on the right print visible as a black pattern against a brilliant blue-green background. This pattern can easily be examined through a small telescope or it can be photographed and enlarged to any convenient size for close study.

One advantage of Dr. Lucas' invention, on which a patent has just been granted, is that the presence of printing or writing on the paper does not obscure the fingerprint pattern. The light by which the print is viewed is invisible to the eye and hence any writing on the paper could not be seen.

## Parapsychology

PARAPSYCHOLOGY! A new scientific term to describe a new scientific approach to an old subject. Making its bow at Duke University, a new journal, and the first in its field to appear under the sanction of a recognized university, will be devoted to clairvoyance, telepathy, and other arts of mind-to-mind communication without benefit of the inventions of science.

"Para" means beside. In the Greek from which it comes, it also had such meanings as "amiss, faulty, irregular, disordered, improper, wrong," according to the Oxford dictionary. These latter meanings are probably not intended by the sponsors of the new journal devoted to parapsychology, however, for the editors, Prof. William McDougall and Dr. J. B. Rhine, are convinced that men can trasmit ideas without recourse to wires, radio, postal facilities or even speech—"extra-sensory perception" they call the art.

For many centuries man has sought the means for looking into the minds and hearts of his fellow men. Perhaps it is because communication arts, amazing as the radio and telephone, telegraph and television are today, lag still behind the fleetness of human thought. Perhaps it is because of the truth of the saying that words are but a cloak to hide thoughts. Man has need to supplement the clumsy inadequacy of his language skill; he needs also to pierce the veil of human deception.

If there exists a way to reveal our thoughts to others without the medium of voice or post or printing press, then the persistent conscientious research of enthusiasts in the field of parapsychology should demonstrate it.

On the other hand, if such hopes are a delusion luring the credulous into the murky pathways of morbid self-deceit, then such research and accurate careful publication and dissemination of the findings should serve as a most useful aid to Amer-

# CURRENT BULLETIN BRIEFS

*(Bulletins listed as being obtainable through Scientific American can be supplied only by mail)*

YOU BET YOUR LIFE! is a review of America's shameful automobile accident record, presented in such dramatic form that it can not fail to drive home to the motorist the chances that he takes when he operates his car on the highway. Dramatization is effected by a series of carefully worked-out drawings and accompanying text Tabulations serve to sum up the entire situation. *The Travelers Insurance Company, Hartford, Connecticut.—Gratis.*

THE HARDEST MATERIAL EVER PRODUCED BY MAN FOR COMMERCIAL USE is the story of the production in the electric furnace of an entirely new substance—Norbide. This material, a close approach to the diamond in hardness, is used in both granulated and molded form for various types of abrasive work in industries. The booklet tells the story of the manufacture, characteristics, and uses of Norbide and presents several interesting photographs. *Write for Bulletin 537A to Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

THE REALITIES OF UNEMPLOYMENT, by Harry L. Hopkins, is an attempt to face the facts of the present situation in the United States and to point out what can be done about the unemployed and the unemployable. *Works Progress Administration, Washington, D. C.—Gratis.*

KNOW YOUR ROPES is an 80-page booklet concerned particularly with the selection of wire rope and its applications and uses. Particular stress is laid on increasing working life of wire ropes in any industry that uses such material. Many illustrations throughout the booklet show the right and wrong ways of handling and applying wire rope. Since this booklet is of interest only to those who have particular use for wire rope, please make your request for it on your business letterhead. *Wickwire Spencer Steel Company, 41 East 42nd Street, New York, New York.—Gratis.*

YESTERDAY AND TODAY IN REFRIGERATION is a brief, factual survey of the principles and history of refrigeration, together with a simple explanation of the operation of a modern electric refrigerator, accompanied by a drawing that makes everything plain. *Write for Bulletin 537C to Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

THE STORY OF NEOPRENE is told in non-technical language with strict attention to scientific accuracy. Neoprene is one of the so-called "synthetic rubbers" and was originally produced under the name "DuPrene." This 6-page pamphlet tells of the discovery of the material, its commercial development, and its significance to science and industry. *E. I. du Pont de Nemours & Company, Inc., Wilmington, Delaware.—Gratis.*

STRENGTH PLUS—MONEL FOR MECHANICAL JOBS outlines briefly yet clearly the various industrial applications of Monel Metal. A few of the industries covered in plants, steam turbines and lines, transmission lines, sewage disposal, refrigeration, and railroads. Applications from the smallest to the largest are illustrated and described. *Write for Bulletin 537D to Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

NORTON ABRASIVES FOR THE LAPIDARY is a condensed study of abrasive wheels and polishing and buffing powders used in lapidary work, based on the experience and accepted practice of many lapidaries—*Norton Company, Worcester, Massachusetts.—Gratis.*

RADIO receivers, transmitters, service equipment, public address systems, and parts for all these lines are listed in a comprehensive radio catalog now available: contains over 116 pages. *Write for Bulletin 537E to Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

ALIGNMENT CHARTS, THEIR CONSTRUCTION AND USE, by Paul N. Lehoczky. Alignment charts are frequently of value to the engineer for obtaining solutions to certain problems quickly and accurately, yet the subject of these charts is one that is not very familiar to a good many who could benefit directly by their use. In the present book the author has told how to design and use these charts. *The Director, Engineering Experiment Station, The Ohio State University, Columbus, Ohio.—40 cents.*

THE INTER-AMERICAN CONFERENCE FOR THE MAINTENANCE OF PEACE is contained in the March 1937 number of *International Conciliation*. This issue records the proceedings of the Conference, held at Buenos Aires, Argentina, December 1-23, 1936. *Carnegie Endowment for International Peace, Division of Intercourse and Education, 405 West 117 Street, New York City.—Single copies, 5 cents; subscription, 25 cents a year.*

"HOT MONEY" VS. FROZEN FUNDS, by Francis P. Garvan, is a noteworthy attempt at analysis of the situation of American investments abroad, presented in a spirit of helpfulness and with a cordial invitation for comments and criticisms. *The Chemical Foundation, Inc., 654 Madison Avenue, New York City—Gratis.*

CABINETS of all types for use in machine shops and factories are described and illustrated in this folded circular. Some of the types described are drill cabinets, cabinets for small parts, shelf boxes, and unit cabinets that can be purchased from stock and made up into combinations to fit almost any available wall space. *Write for Bulletin 537F to Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

NICKEL ALLOY STEELS IN PETROLEUM PRODUCTION EQUIPMENT, Bulletin U 2, is of particular interest to oil-well drillers and workers in the oil fields. It describes and illustrates several types of new equipment. *The International Nickel Company, Inc.,*

# Books SELECTED BY THE EDITORS

## MORE FOR YOUR MONEY

*By H. Bennett*

WHEN you purchase a new automobile, new furniture, fabrics, clothing, toilet requisites, your choice depends upon your past experience and the experience of others who have used similar products and found them either satisfactory or unsatisfactory. Often, you are disappointed in what you bought. "More for Your Money" is a buyers' guide built upon the assumption that you don't like to be fooled, especially where your own hard-earned cash is involved. It would be a hopeless task to attempt to outline the numerous fields covered by this book; hence we will limit ourselves to a statement that it does discuss practically every article in everyday use from toothpaste to furniture and building materials. It gives you not just the personal experiences of a friend but the results of scientific tests; tells you how to choose that product which will give you the best wear, dollar for dollar. Probably one of its most important features is its exposure of the tricks used in selling certain types of products. It will unquestionably save for the purchaser many times its own cost.—$2.90 postpaid.—*F. D. M.*

## TELEVISION RECEPTION

*By Manfred von Ardenne, translated by O. S. Puckle*

DEVOTED mainly to television equipment used in Germany, this discussion gives the technical background and details that bring the readers thoroughly up to date with electronic television.—$2.90 postpaid.—*A. P. P.*

## BEING BORN

*By Frances Bruce Strain*

THE following is quoted from the *Journal of the American Medical Association's* review of this book on sex and reproduction for children of pre-adolescent age: "This is a book to arouse enthusiasm. It tells everything a young person could wish to know about sex. It uses scientific terminology. It is devoid of emotionalism and sentimentality. It is clear and concise. The method is effective. There is no preaching in this book, and therein lies its power. While it is unemotional and scientific, it is not cold, but friendly and personal. Throughout, the work shows profound thought, meticulous care, and a sym-

gether, it is an admirable work." With all of this we heartily agree.

It is interesting to note that modern books such as this, written for children, tell even more about the "facts of life" than books purporting to tell "what a young bride or groom ought to know" were presenting a generation ago. In those days they piously left the children to pick it up at the same age but from the gutter.—$1.65 postpaid.—*A. G. I.*

## MEXICO TODAY

*By Colonel Irving Speed Wallace*

TRAVEL books can be of two kinds; they may be dry-as-dust compilations of facts and statistics, or they may be exceedingly interesting narratives concerning foreign lands. "Mexico Today" falls within the latter category and, with its liberal serving of outstanding photographs, tells the story of our ancient yet modern southern neighbor. Read for general interest and information, the book is entirely worthwhile; used as an unconventional guidebook to Mexico, it is priceless.—$2.15 postpaid.—*A. P. P.*

## SCIENCE REDISCOVERS GOD

*By Barclay Moon Newman*

THE author's main thesis is that the universe is a purposive mechanism and that man is its central figure. The God it arrives at is not the conventional one but the Grand Architect. This book is for thoughtful students of the philosophy of science and is the antithesis of anything either emotional or light and fluffy, like some books with similar titles. It is a Book-of-the-Month-Club recommendation.—$2.15 postpaid.—*A. G. I.*

## PICTURING MIRACLES OF PLANT AND ANIMAL LIFE

*By Arthur C. Pillsbury*

MR. PILLSBURY'S engrossing account of his pioneering efforts in developing lapse-time photography will be read with interest and profit by the botanist, the amateur photographer, and the general reader. Written in the clear, unassuming style of the scientist conscious of the romance intrinsic in his achievements, the work is a solid and valuable contribution to the literature of scientific photography. Mr. Pillsbury's story of the remarkable methods

pre-determined intervals such matters as the growth of a plant over the course of days or weeks is prefaced by some helpful hints to those who would go and do likewise—if they can afford the price. Illustrated with 66 of the author's own photographs, the book discusses his experiences in photographing by lapse-time methods such subjects as flowers, pollenization, cactus and succulents, leaves, under-sea scenes, and so on.—$3.20 postpaid.—*J. D.*

## SHIPS OF THE WORLD'S BATTLEFLEETS

*Edited by Pay-Lieut. Comdr. E. C. Talbot-Booth, R. N. R.*

ALMOST a miniature edition of one well-known annual book on the world's navies, this volume gives the essential facts regarding the principal ships in the navies of the important powers. There is considerable discussion regarding the details of construction, as well as numerous silhouette drawings and quite a large number of photographs. In our opinion it is well worth the small amount charged for it.—$1.65 postpaid.—*F. D. M.*

## THE INSECT MAN

*By Eleanor Doorly*

A JUVENILE tale about the life of Fabre, the naturalist, for youngsters. Oldster admirers of Fabre would enjoy it equally well.—$1.65 postpaid. —*A. G. I.*

## AIR CONDITIONING—INSULATION

*By J. Ralph Dalzell and James McKinney*

AS has been pointed out many times in this magazine there is a great deal more to the relatively new science of air conditioning than the mere installation of the equipment itself. The public seems to gain the impression that the air-conditioning unit is practically the sole consideration and engineers will have a difficult job educating these same people into the mysteries of the necessary insulation for houses that must accompany an air-conditioning installation. The engineer himself must, however, gain a good foundation in this branch of the new science and he might well do so from this new volume. The authors discuss in detail the many types of insulation, old and new, for the walls and floors of houses and for the air-conditioning equipment itself. They

to the products of those large companies which have developed the more modern forms of insulation and have gone into much detail to explain their relative merits, cost, and the like. Many pictures are given and there are numerous working drawings of many kinds of insulation. In addition, there are many tables, and mathematics for heat transmission, heat losses, fuel saving and such are given.—$2.65 postpaid.—*F. D. M.*

### READING FOR SKILL

*By Angela M. Broening, Ph.D., Frederick H. Law, Ph.D., Mary S. Wilkinson, A. B., and Caroline L. Ziegler, M.Ed.*

ADMIRABLY brought out in this book is the fact that reading is not merely the use of the eyes to carry to the brain the meaning of printed words. Reading encompasses much more than just this, particularly if it is desired to read intelligently, rapidly, and skilfully. The book serves as a guide for students—either in school or out—who realize the desirability of absorbing knowledge by reading and who wish to do so with the least possible effort and the greatest possible result.—$1.35 postpaid.—*A. P. P.*

A separate volume is identical with the first except for the fact that it includes a section at the back entitled "Key to Exercises and Check Tests," apparently for the benefit of teachers. The two volumes are readily differentiated between, since the former's cover is lettered boldly in red, while the cover of the latter is lettered in blue.—$1.45 postpaid.—*A. P. P.*

### SUPREME COURT OR POLITICAL PUPPETS?

*By David Lawrence*

A SMALL, compact volume of arguments against the rape of the Supreme Court.—$0.60 postpaid.—*A. G. I.*

### ART AND THE MACHINE

*By Sheldon Cheney and Martha Cheney*

"INCONGRUOUS" is the word you think of when you have seen the photograph in this volume of a gas stove by Norman Bel Geddes. Yet this typifies the trend of industrial design today. Artists noted in their own right have been employed in increasing numbers by industrial firms that make all manner of utilitarian products with the purpose of dressing up these products, making them more attractive and salable. It is the modern "eye appeal" under consideration here—the eye appeal which is the last little touch on a product which already may be a masterpiece mechanically.

The authors discuss this trend from the time Norman Bel Geddes opened the

tory just ten years ago, and show by numerous illustrations the effect of this new design-consciousness upon numerous products in everyday use Much attention is, of course, given to modern building construction, both interior and exterior, and to the design of such things as trains and automobiles. There is no doubt that this new profession has tremendous potentialities for the future.—$3.95 postpaid.—*F. D. M.*

## READING, WRITING AND SPEECH PROBLEMS IN CHILDREN

*By Samuel Torrey Orton, M. D., Former Professor of Neurology and Neuropathology, Columbia University*

DESCRIBES peculiarities such as word blindness, word deafness, aphasia, inability to write, reading disability, speech delay, clumsiness, stuttering; and throws some light on their treatment.—$2.15 postpaid.—*A. G. I.*

## THE COSMETIC FORMULARY

*By H. Bennett*

THERE has long been a demand for just such a book which would give usable formulas on all types of cosmetics. Perhaps the wait was long but the result was well worth waiting for. While offhand it may seem to be a professional book it is an excellent one for the layman who might wish to make, for example, the cold cream for his family and thereby save in a year's time much more than the cost of the book. It contains hundreds of formulas on bath preparations, creams, dentifrices, hair preparations, nail polishes, perfumes, soaps, skin ointments, powders, lotions, and many other products.—$3.90 postpaid.—*F. D. M.*

## STARS AND PLANETS

*By Donald H. Menzel, Assoc. Professor of Astronomy, Harvard University*

A VERY compact, very popular exposition of the science of astronomy, suitable for readers who have no previous knowledge of the subject whatever, but do not expect to learn it all at the first bite.—$1.15 postpaid.—*A. G. I.*

## ACCIDENTS AND THEIR PREVENTION

*By H. M. Vernon*

FROM minor accidents in the home up to and including fatal accidents on the highway, the author covers the whole field of this tremendously important problem. He analyzes carefully the reasons for accidents and discusses preventive measures that have been used. A valuable contribution to the literature is contained in the suggestions given for additional methods of avoiding acci-

dents. The book is based on a thorough study of the entire situation and a careful consideration of its content should go far toward making life more worth living, and living more possible.—$5.20 postpaid.—*A. P. P.*

## CHILDLESS

*By Sam Gordon Berkow, M. D.*

A STUDY of sterility, its causes and treatment, including discussions of our sterile civilization, how we reproduce, and the conquest of sterility. Childless parents should be able to extract a great deal of scientific knowledge from this book.—$3.15 postpaid.—*A. G. I.*

## EVERY BOY'S BOOK OF SHIPS

*By J. D. Burgan White*

AN illustrated book telling about "blue ribbon" liners, oil tankers, sailing ships, yachts, ships of the British Navy, and other kinds of ships. The source is British—a pretty competent source of knowledge of ships, we must agree.—$1.65 postpaid.—*A. G. I.*

## WHY QUIT OUR OWN

*By George N. Peek with Samuel Crowther*

"THIS book has been conceived and written not in a partisan spirit but solely in an effort to take the question of national prosperity and well-being out of the realm of mere words and theory and to discuss them on the sure basis of fact." We can find no better summary of the present volume than the foregoing quotation from the preface. Regardless of what may be said about the unscientific aspects of the science of economics, the facts and figures discussed in this book will at least furnish food for thought.—$0.60 postpaid.—*A. P. P.*

## RECOLLECTIONS AND REFLECTIONS

*By Sir J. J. Thomson*

THE famous discoverer of the electron and head of the Cavendish Laboratory at Cambridge has written his autobiography, giving the reader an intimate, chatty, and friendly glimpse into his long and eventful life, which included three visits to America where most things met his approval. A fascinating narrative.—$4.20 postpaid.—*A. G. I.*

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# LEGAL HIGH-LIGHTS

## Patent, Trademark, and Related Legal Proceedings That May Have a Direct Effect on Your Business

By ORSON D. MUNN, Litt.B., LL.B., Sc.D.
New York Bar
Editor, Scientific American

### Bank Night

MOVING picture theaters in many parts of the country have adopted the policy of giving prizes, usually monetary prizes, during one or more performances each week for the purpose of increasing patronage. Many different methods of awarding the prizes have been employed.

In a recent case before one of the federal circuit courts of appeals, the plaintiff was the originator of a plan or system for awarding monetary prizes in theaters or other places of entertainment and had designated its plan or system by the name "Bank Night." The plaintiff printed a set of instructions describing the plan or system and the manner of carrying it out. This instruction sheet was duly copyrighted by the plaintiff. In addition, plaintiff had caused the name "Bank Night" to be registered as a trade mark with the Secretary of State of the State of Oklahoma. Plaintiff derived its income by licensing theaters to use its plan or system.

It was alleged by the plaintiff that the defendant had copied its plan or system, and also its name "Bank Night," and plaintiff contended that the use of the system was copyright infringement and the use of its name "Bank Night" was trade mark infringement. The court rejected both of plaintiff's contentions, finding that defendant had a right to use both the system and the name "Bank Night." In reaching this conclusion, the court found that defendant had not reproduced the instruction sheet which was copyrighted by plaintiff, but at most had carried out the teachings set forth in the instruction sheet. The court pointed out that a copyright on a book is only infringed by a printing of the book or any material part thereof, and that the practicing of an art taught in the book did not constitute copyright infringement.

With regard to the alleged trade mark "Bank Night," the court found that plaintiff was not engaged in the sale of merchandise to which it affixed a trade mark, but at most was selling a plan or system. The court then said:

"We fail to find legislative provision or judicial approval and sanction of the use of trade marks with a plan or system of action."

This case, while dealing with a subject matter of a rather frivolous or light nature, is based upon fundamental and important principles of law. Business men, merchandisers, and advertisers frequently attempt to secure protection for a plan or system of action, such as a plan of advertising or a plan of doing business. Under our law no type of protection can be secured for such plans or systems of action. If the plan or system is printed in pamphlet or book form and the pamphlet or book is then copyrighted, the copyright merely protects against the unauthorized reproduction of the pamphlet or book or any substantial part thereof, but does not prevent the practicing of the plan or system described in the pamphlet or book.

### Cartography

IF you are considering adopting the map of a country as a trademark, due consideration should be given to a recent decision by the United States Court of Customs and Patent Appeals in a case involving a well-known manufacturer of ginger ale. The ginger-ale manufacturer attempted to register in the United States Patent Office under the important Trademark Act of 1905 the map of Canada as a trademark for soft drinks. The Examiner of Trademarks and the Commissioner of Patents both refused to register the mark and an appeal was taken to the Court of Customs and Patent Appeals.

In its decision the Court held that registration of the map of Canada as a trademark was rightfully refused. In reaching this decision the Court pointed out that the Trademark Act of 1905 forbids the registration of a trademark which consists of "merely a geographical name or term." The names of countries, cities, and other geographical sub-divisions had long been refused registration under the Trademark Act of 1905 due to this provision.

Prior to the present decision, however, the Courts had not passed upon the applicability of the above provision to a trademark consisting of a map. The Court of Customs and Patent Appeals found that the map of Canada was geographical and therefore could not be registered under the Trademark Act of 1905. The provision of the Trademark Act of 1905 which prohibits the registration of a trademark which is merely a geographical name or term might at first glance appear to be arbitrary. The reason underlying this provision, however, is a sound one, namely, that every manufacturer should have the right to indicate the place of production of his product and no single manufacturer should have the exclusive right to use the name of that place.

### About Face

THE Court of Appeals of the State of New York recently sustained the so-called Fair Trade Statute of the State of New York, reversing its own decision of January, 1936, in which a portion of the statute was declared to be unconstitutional. The statute provides that any contract fixing the resale price of a commodity bearing the wrapper, trademark, brand, or name of the producer is legal, and that wilfully and knowingly advertising or offering for sale any commodity bearing the wrapper, trademark, brand, or name of the producer below the stipulated price is an act of unfair competition.

In January, 1936, the Court of Appeals had held that this statute was in part unconstitutional. Since that decision the United States Supreme Court passed upon a similar statute of the State of Illinois and held that the statute was constitutional. The Supreme Court decision was discussed on this page in the February 1937 issue. Without re-enactment of the statute, the Court of Appeals of the State of New York has now reversed its former decision in view of the Supreme Court decision and has held the statute to be constitutional.

This decision is of far reaching importance and is a further illustration of the growing importance of trademarks. Heretofore any attempts to fix the resale prices of commodities by contract have been frowned upon under our system of law. Under the decisions of the New York State Court of Appeals and the United States Supreme Court, the owner of a trademark can, in those states having similar Fair Trade Statutes, control the prices at which his products are sold at retail.

The decision is interesting for another reason, in that it clearly brings out the difference between a judicial declaration of invalidity of a statute and an executive veto. Where a statute is vetoed by an executive, it must be re-enacted to become law. The New York State Fair Trade Statute had been declared unconstitutional in January, 1936, by the highest Court of the State, and then without re-enactment of the statute it is now declared by the same Court to be constitutional.

### Strictly Personal

ADVERTISERS are constantly advising the American public in the magazines and newspapers and over the radio of the nature and purpose of such articles as depilatories and deodorants. Seldom, however, do the Courts of the land lend their austere dignity to an exposition of the nature of such products.

In a recent case before the Court of Customs and Patent Appeals the Court found it necessary to expound upon this subject. In that case the manufacturer of a dipilatory attempted to register the trademark "Voo" for depilatories in the United States Patent Office and his application for registration was opposed by the owner and user of the trademark "Dew" for deodorants. The owner of the trademark "Dew" claimed that he would be damaged by the registration of the trademark "Voo" for depilatories. The Court sustained his contention and refused to allow the registration of the trademark "Voo."

In deciding the case the Court had to consider whether depilatories and deodorants were goods of the same descriptive properties, and in this connection stated:

"Depilatories unquestionably are of the same descriptive properties as deodorants—one removes hair, the other removes odors. Both are for personal application, and are sold in the same places and to the same class of casual purchasers."

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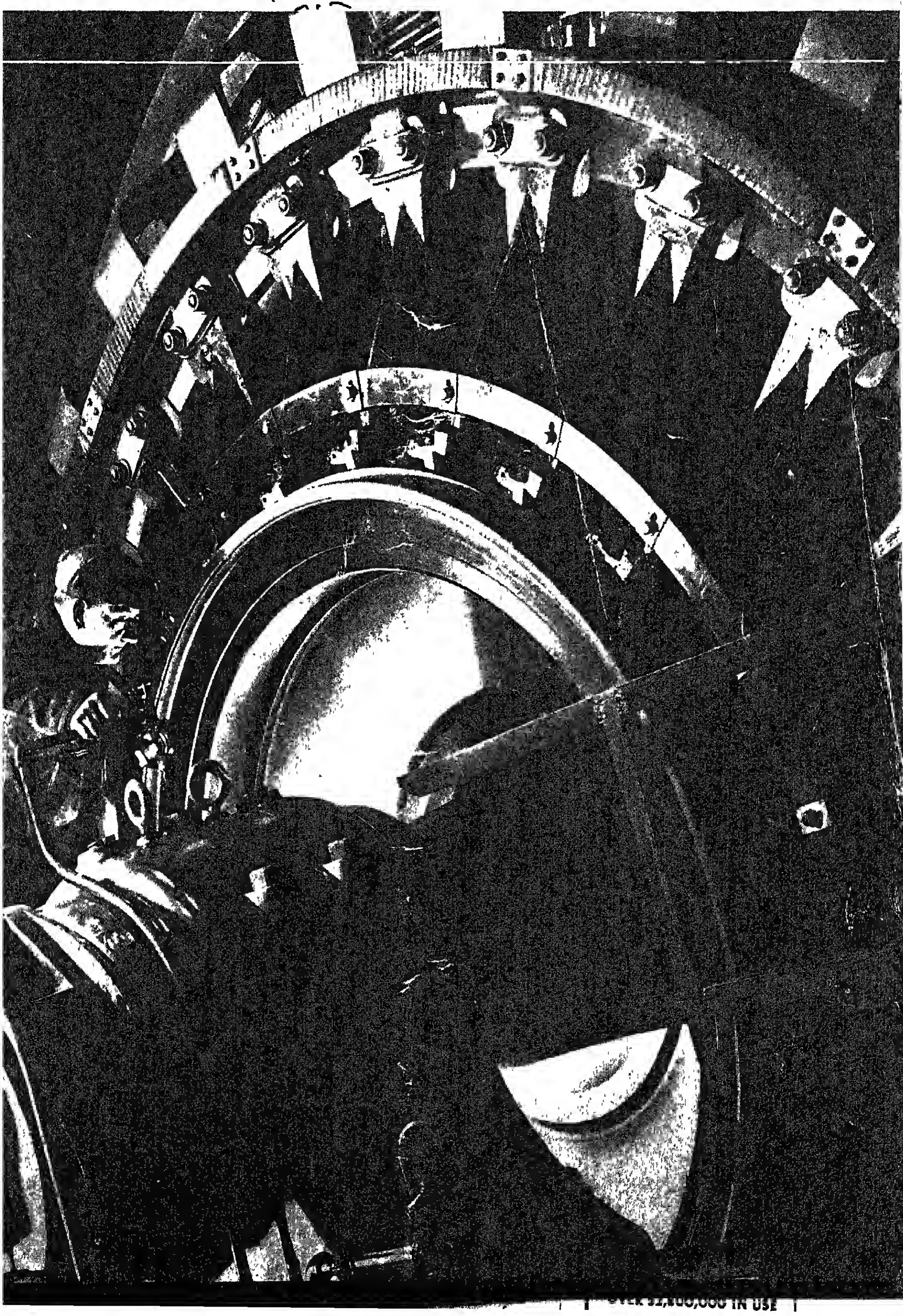

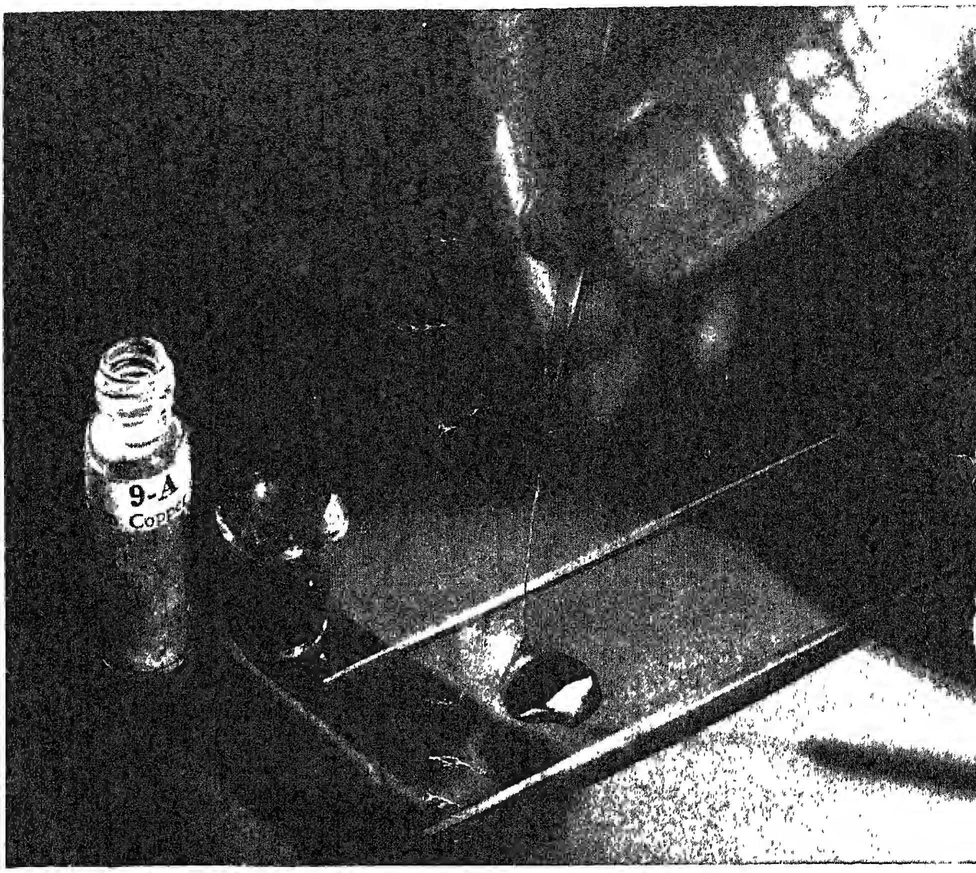


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NINETY-THIRD YEAR • ORSON D. MUNN, Editor

12-6-37

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THIS month's cover shows one of the four shunt-wound variable-speed 5000-horsepower Allis-Chalmers direct-current motors driving individual four-high finishing roll stands of a semi-continuous 120-inch hot-strip steel plate rolling mill in the Carnegie-Illinois Steel Corporation's plant at Homestead, Pennsylvania. These are the highest powered individual roll stand drives in any of the new continuous mills operating in the United States. The speed of these large motors is under the supervision of a pulpit operator.

## The SCIENTIFIC AMERICAN DIGEST



SCIENTIFIC AMERICAN, June, 1937. Vol. No. 156, No. 6, entered at the New York, N. Y. Post Office as second class matter June 28, 1879, under the act of March 3rd, 1870; additional entry at Greenwich, Conn. Published monthly by Munn & Company, Inc., 24 West 40th Street, New York City.  Subscription price $4.00 per year. Canada $4.50. Foreign $5.00. Manuscripts are submitted at the author's risk and cannot be returned unless accompanied by postage.

# 50 Years Ago in . . .

# Scientific American

*(Condensed From Issues of June, 1887)*

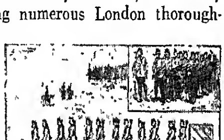
DOGS—"Careful experiments on the sense of smell in dogs have been made by George J. Romanes, who has communicated the results to the Linnaean Society of London. He finds that not only the feet, but the whole body of a man exhale a peculiar or individual odor, which a dog can recognize as that of his master amid a crowd of other persons; that the individual quality of this odor can be recognized at great distances in any direction; and that even powerful perfumes may not overcome this odor."

SEWERS—"Some system of constant artificial ventilation for sewers is, in the opinion of some of the most competent authorities, absolutely necessary, if we would be thoroughly rid of the deadly pest of sewer gas. Alanson Sibley . . . advocates for this purpose a furnace and chimney of strong draught, at the mouth of the main sewer, to create a constant suction of the gases away from the houses and into a consuming chamber in the furnace."

LIFE AND DEATH—"It has been computed that the death rate of the globe is 67 a minute, 97,790 a day, and 35,639,835 a year, and the birth rate 70 a minute, 100,800 a day, and 36,792,000 a year."

TYPEWRITER—"Among other advantages claimed for the Hammond typewriter are that it is compact in form and portable, weighing only 15 pounds; that the action is simple, and the machine easily worked by reasons of the accessibility of the keyboard and the disposition of the keys, and that the paper is not horizontal, but vertical, and is therefore easily read by the operator as he works."

MULTICYCLE—"This machine, manned by ten men, which may recently have been seen traversing numerous London thoroughfares, is Messrs. Singer & Co.'s latest adaptation of their 'Victoria' or 'Four-in-Hand' quadricycle, and is intended for the rapid transport of infantry from one point to another. When fully manned, it carries twelve men, who can take with them, if necessary, a light baggage cart or ammunition wagon. By thus mounting the riders in single file, instead of two or four abreast, the machine is both rendered more manageable and it also presents less surface to a strong head wind. The speed got out of this machine is surprising. Ten miles an hour is a low average rate, and sixteen have been easily accomplished."



SPEED AFLOAT—"Messrs. Thornycroft & Co., of Chiswick, in making preliminary trials of a torpedo boat built by them for the Spanish Navy, have obtained a speed which is worthy of special record. The boat is twin-screw, and the principal dimensions are: Length 147 ft. 6 in., beam 14 ft. 6 in., by 4 ft. 9 in. draught. On a trial at Lower Hope, on April 27, the remarkable mean speed of 26.11 knots was attained, being equal to a speed of 30.06 miles an hour, which is the highest speed yet attained by any vessel afloat."

ALUMINUM-SILVER—"Alloyed with a small percent of silver, aluminum loses much of its malleability, but with 5 percent of silver it can be worked well, and takes a more beautiful polish than the pure metal. With 3 percent of silver it is very suitable for philosophical instruments, being harder and whiter than the pure metal, and is not tarnished even by sulphureted hydrogen."

PLATINUM—"It has been demonstrated that platinum wire may be drawn so fine as to be invisible to the naked eye, although its presence upon a perfectly white card can be detected by the touch."

SUBMARINE—"The new Nordenfelt submarine torpedo boat . . . is the largest of its kind as yet launched, being 100 feet long, 12 feet beam, 160 tons displacement, and is engined to 250 horse power. She is able to descend to a depth of 50 feet, to remain submerged some nine hours, and proceed at a maximum speed of ten knots. Her coal capacity is sufficient to enable her to steam for 900 knots without taking in a fresh supply . . . The motive power is steam, and Mr. Nordenfelt can store up the heat necessary for its generation when the boat is submerged and combustion is no longer possible."

OARS—"Yates & Co., Birmingham, are making an oar in which the blade is made from the best sheet steel, highly tempered. It is put forward as being much stronger than the ordinary wooden one, and cannot be broken without undue violence. The handle fits into a socket running nearly the whole length of the blade, and forming a backbone of great strength."

SNAKES—"Statistics show that about twenty thousand people are annually destroyed in India by animals, and of these, nineteen out of twenty are said to be bitten by snakes."

EDISON—"Mr. Thomas A. Edison, the famous electrician, has a very handsome residence in Llewellyn Park, Orange, N. J., and he is about to erect outside of the park a three story brick building, 250 x 60 feet, for conducting his experiments and as a repository for his books, drawings, models, etc."

MONEY—"At the present time, deducting the money held by the Treasury and the banks, the amount of circulation really in the hands of the people can hardly fall, says the Baltimore *Sun*, much short of $900,000,000, or about $16.25 to every man, woman, and child in the country."

SPIRITUALISM—"After an extended and painstaking investigation, a commission appointed by the University of Pennsylvania, to see what there was in 'modern spiritualism,' have concluded their labors. They find that it is made up of equal parts of humbug and jugglery, calculated to deceive only the credulous or feeble-minded. In their summing up they . . . are . . . 'forced to the conclusion that spiritualism . . . presents the melancholy spectacle of gross fraud.'"

AND NOW FOR THE FUTURE

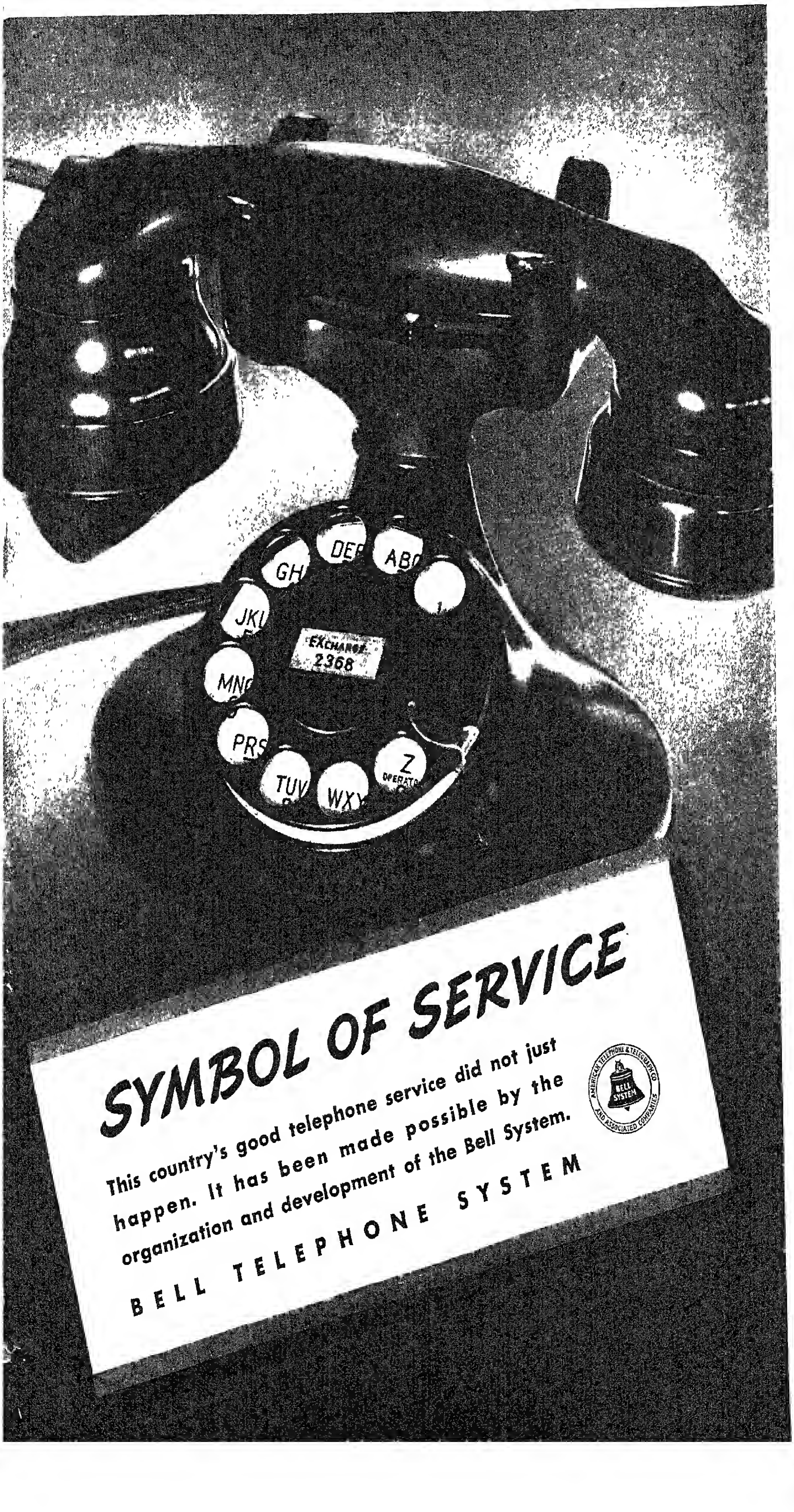
**¶Radium: The whole story from discovery to the present day, by John A. Maloney**

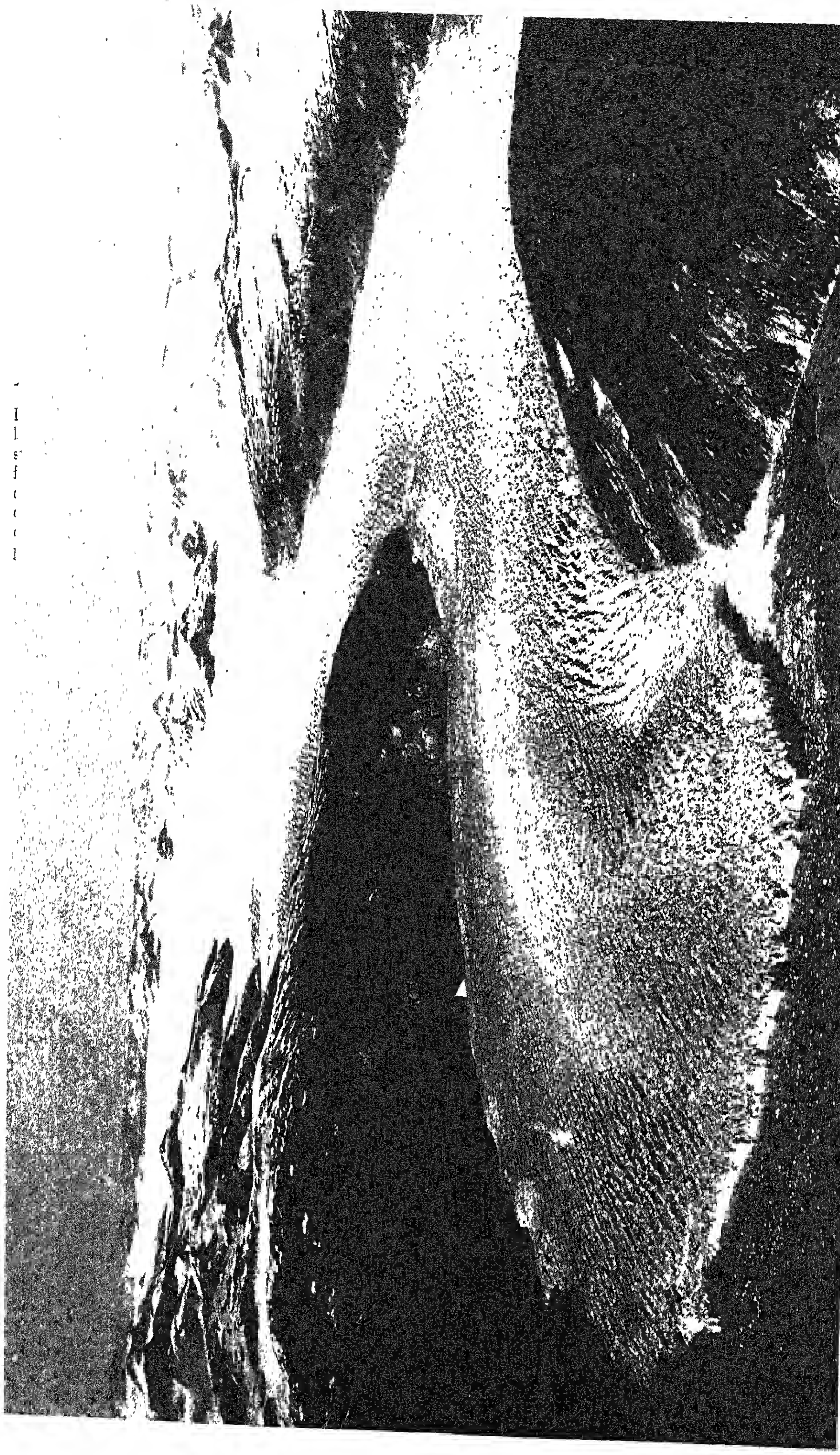
**¶Aircraft Engines: Latest developments in the field, by Reginald M. Cleveland**

**¶Submarines: Their place in modern navies, by Walton L. Robinson**

**¶Doctors: Scientific aids of the medical men, by Morris Fishbein, M.D.**

**¶Quail: What California is doing to provide better hunting, by Andrew R. Boone**


EXCHANGE 2368
SYMBOL OF SERVICE
This country's good telephone service did not just happen. It has been made possible by the organization and development of the Bell System.
BELL TELEPHONE SYSTEM
AMERICAN TELEPHONE & TELEGRAPH CO AND ASSOCIATED COMPANIES
BELL SYSTEM



TAKU GLACIER DISCHARGING INTO AN ARM OF THE PACIFIC

JUST south of Juneau in Alaska is Taku Glacier which starts 30 miles back in the mountains and discharges into Taku Inlet, an arm of the Pacific. Its dimensions are much greater than this plane's-eye view suggests—its length 30 miles, its width two to three miles. At its front large bergs calve off into the sea, their above-water portion being about 300 feet in height. Its daily movement is about ten feet or, roughly, an inch every 12 minutes

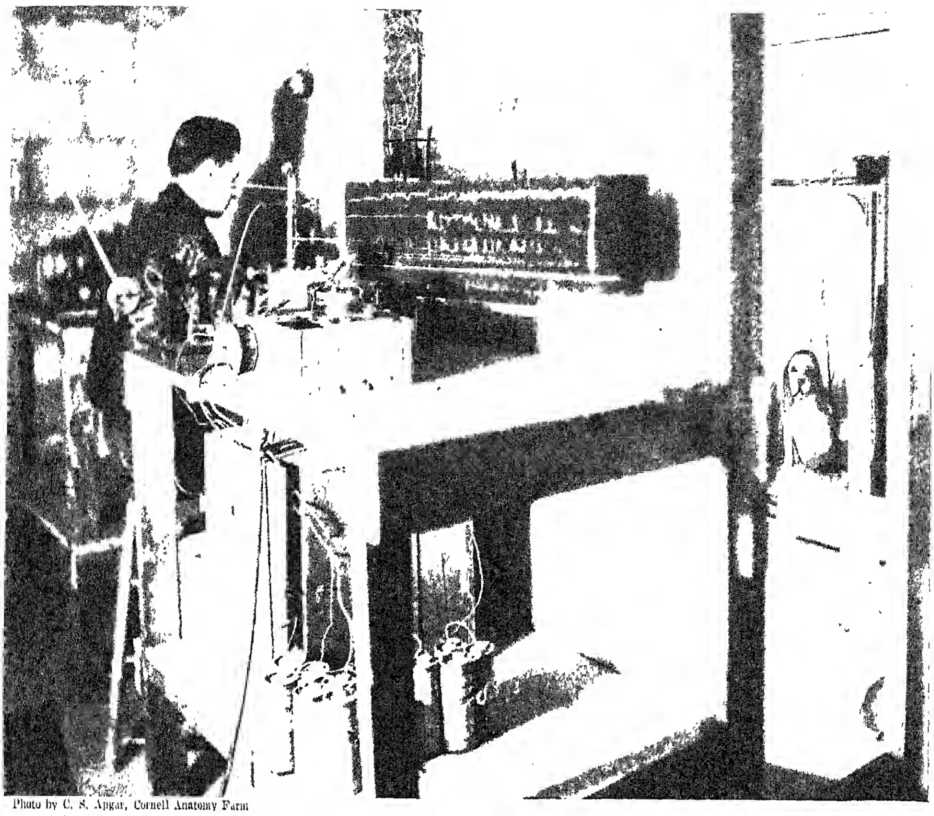


Photo by C. S. Apgar, Cornell Anatomy Farm

The experimental room and, through the door, the animal room of the Conditioned Reflex Laboratory at the Cornell Anatomy Farm. With the door closed the animal is free from disturbing sounds. Note experimental dog through door

# ME AND MY DOG

## Can Dogs Think? Lacking in Three Vast Advantages Humans Enjoy and Take for Granted, Dogs Cannot Be Regarded Scientifically as Thinking Animals


By G. H. ESTABROOKS

Professor of Psychology at Colgate University


CAN your dog think? "Certainly," you say. "Certainly not," says the psychologist. Then we have all the makings of a good row, for the dog is man's best friend, to be treated with respect and reverence, even by the man of science. Perhaps in this article we can shed a little light on the argument, always remembering that, as is the case with most arguments, the whole fuss may be over a confusion of terms. Learning and thinking are not the same.

Undoubtedly, your dog can learn. So can those tiny one-celled microscopic animals we call protozoa. Not much, to be sure, but a little and, as the organism becomes more complex, it learns more. A snail is really bright—compared with a protozoan; while a minnow could almost draw up your income tax return—relatively speaking. But let us concentrate on the dog, which is, of course, immensely superior to any of these others.

As a first point of interest, the dog is one of those animals with a backbone and a brain. We call him a vertebrate, and man falls in the same group. These vertebrates are specialized in such a way that they cannot learn without the brain, probably differing here from other groups, such as those including the snail, the bee, or the starfish. We can illustrate this need of a brain very nicely by using the so-called "spinal dog." This is the animal in which the brain has been separated from the spine so that the brain is of no use at all in running the body. This spinal animal is still a pretty good dog. He can walk, eat, bark and bite, but he is "dumb" beyond anything you ever dreamed of. He just can't learn a thing. Suppose, for illustration, you place a red-hot electric grill in the room. The light attracts his attention, so he walks up to the glowing metal and solemnly touches it with his nose. This results in a yelp and a headlong retreat. Ten seconds later the grill again catches his eye, so he approaches again, dabs it with his nose and admits he doesn't like it with another startling yelp. This would go on indefinitely until there was no nose left, but of course it is not permitted. The point is that without a brain he cannot learn even such a simple and painful lesson as the above.

Given his normal brain, on the other hand, your dog can readily perform wonders. This is no better illustrated than in the works of the great Russian physi-

ologist, Pavlov, father of the so-called "conditioned reflex." He made a most interesting series of experiments and discoveries. For example, if you feed a dog meat you get a flow of saliva. His mouth waters, and so does yours under a similar circumstance. Pavlov invented a very simple apparatus by which he could measure accurately the amount of saliva secreted during a meal. Then he proceeded to demonstrate the conditioned reflex.

For instance, he would shine a red light in the dog's eyes while the animal was eating. He would repeat this procedure several times and then, believe it or not, he had only to turn on the red light and the dog's mouth would "water" just as heartily as if he were having his usual meal. The light was the dinner bell, so to speak, and Pavlov found that practically any stimulus associated with food would give the same result. The sounding of a musical note or the ticking of a clock, patting the head or scratching the back, an ice pack on his left paw or a hot-water bottle on his right, all gave the same reaction, providing they were experienced by the dog while eating his meal. In other words, any of these unusual or "conditioned" stimuli would, in and of themselves, produce the flow of saliva if they were first associated with the "normal" stimulus, food.

Other investigators were quick to realize the possibilities of the conditioned reflex, which was soon advanced as explaining a great deal of learning, both animal and human. It was soon found that practically any response, be it of glands, organs, or voluntary muscles, could be conditioned. Take little Johnny, for example, and the reaction of crying. As a very young baby there are relatively few things that will make him cry, your neighbors to the contrary. But, as one of my acquaintances said of Einstein, "He's bright. He catches on quick." One of the few normal or natural stimuli to crying is a loud noise, but a small child has no fear of, say, a cat. Now suppose little Johnny is playing with the cat when you sound a gong behind his head. He at once starts to cry. You repeat this experiment several times and, lo and behold, the sight of the cat alone is enough to start him crying. You have built in him a fear of cats which may last through his entire lifetime.

Very fortunately, it also works the other way around. If, for reasons unknown, you find that your child does not like cats, it is often possible to reverse this attitude by associating puss with something the child does like, such as eating. Care is necessary here, as a too sudden intrusion of your unpleasant factor might result in vomiting and conditioning the child against his *food* instead of toward the cat. This is exactly what does happen in a great many cases where we resort to punishment. We force the child to do our will, but that unpleasant emotion goes over to the activity in question—say, practicing on the piano. As a result, he will drop it at the very first opportunity, whereas if we associated the piano with something pleasant, the reverse would be the case.

MANY and weird are the results which conditioning will yield on your dog; also very instructive. For example, we can condition him so that he will wag his tail when you stick him with a pin, or bite you when you pat him. He will live on a diet of putrid fish and turn up his nose at good beefsteak. He will curl up and go to sleep in a mud puddle by preference, scorning the comfort of a warm, dry kennel near at hand. If the dog were a human and you ran across these results, you would say he was crazy and clap him into an asylum. As a matter of fact, a great deal of so-called insanity among humans can be explained on this basis. The child gets a bad fright in a closed room. Result is claustrophobia, fear of closed places. Or he becomes very angry at a man with red hair. Later on, as an adult, he has a compulsion to assault every red-headed man he sees—dangerous business.

One medical investigator eclipsed even these crazy results. Playing around with diphtheria toxin, he discovered that a dose of this sent the animal's temperature up. So he gave it regular doses of toxin and every time he shot in the toxin he stimulated the animal's ear. Now he has only to tickle its left ear to get the rise in temperature! We should add that this last piece of research is under heavy fire at the moment, but there is no reason to believe that it wouldn't work. Also, the animal in question was a rabbit, not a dog.

The conditioned reflex explains a great deal of learning, but certain types do not seem to fall under the general laws of conditioning. At any rate they are better understood if treated separately. For example, the facts yielded by so-called "trial-and-error" learning are almost as spectacular as the preceding. We illustrate this best by the use of the problem box. This device is a cage in which the animal is confined. Somewhere within is a hook or a button; when the animal claws the hook or steps on the button it releases a spring, the door opens and the animal escapes. Now we take a hungry dog, cat, or monkey, put him inside the cage and place food outside but beyond his reach.

Naturally, the animal resents this and barks, yowls, or chatters at the top of his voice, all the while jumping around the cage in frantic impatience. Sooner or later he sets off the spring, purely by accident. He dashes out and gets the food. Next day he is hungry again, the experiment is repeated, and so on at regular intervals. But, like Einstein, the animal is bright—he catches on. After a dozen trials the whole picture is altered. The moment you close the door, the animal makes one leap, pounces on the button, releases the spring and is out almost before he is in, relatively speaking. He stumbled on the solution by accident—by trial and error, we say—and then proceeded to master the problem in very quick order.

This trial and error process explains a great deal of human and animal learning. We just go ahead and keep trying, so to speak. Then one of the trials yields success and we promptly mark that as the one to be used on all future occasions. This process is of enormous importance, not only in everyday life, but even in the development of insanity. Johnny doesn't wish to attend school.

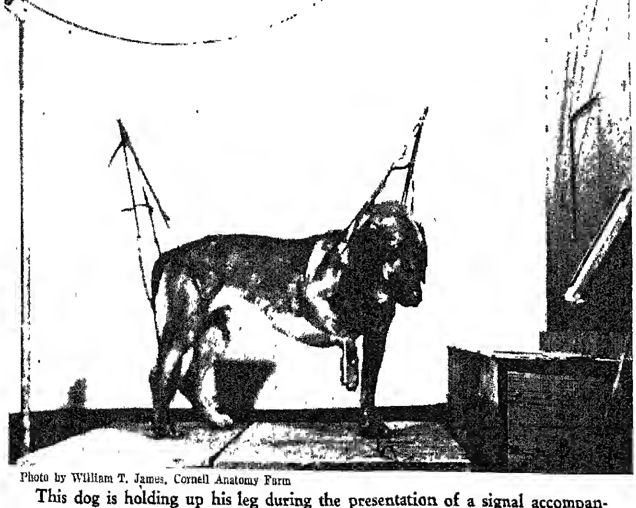


Photo by William T. James, Cornell Anatomy Farm

**This dog is holding up his leg during the presentation of a signal accompanied by a liminal shock on the foreleg. With leg raised the shock is avoided**

He hopefully announces a stomach ache. To his utter astonishment it works. Needless to say, he'd be a fool if he didn't use this marvelous new weapon every time he is faced with an unpleasant task, but as an adult, we may put him in an asylum. By then, he has learned to side-step reality so beautifully that he has waltzed right out of the picture.

The human being has tremendous advantages over your dog in this trial and error process—all the result of his much greater brain. Let us suppose that neither you nor your dog has ever seen a skunk and your dog discovers one raiding the hen roost. He rushes to die for God, for country; and ten seconds later he wishes he could die for anybody, even for Yale. An hour later, not having seen your dog, you discover Mrs. Skunk engaged in exactly the same process as before. So you seize a baseball bat and advance to the slaughter. Then you are retired, no hits and one error.

So you and your dog have in common a very unpleasant experience, with the added certainty that Mr. and Mrs. Skunk will return in the near future. Here is where you steal several marches on the canine. First, you have the use of language. You can either read about skunks in your library or you can call on one of your neighbors who has lived in the section and who knows skunks. He will solve your problem for you. The dog cannot use language and so is blocked here. Then, second, you can think over the experience after the skunk has gone. Actually, thinking is talking to yourself. A visitor to a state institution said to his guide: "Who is that chap in the corner snapping his fingers." "Him? Oh that's just a deaf and dumb mute with the hiccups." Actually, when the deaf think, they use their fingers just as you often catch yourself using your lips. Thinking is simply a trial and error solution of your problem, with the tremendous advantage that you don't have to risk your body until you are certain of results. You sit back before your fire and visualize the whole situation. You appraise your own weakness, the skunk's strength and decide you will use missile weapons of your own next time: namely, a shotgun. Your dog can't think, in this sense of the word. He must have his enemy right in front of his eyes. Then, to be sure, he will remember the past experience, but he has prepared no solution to the situation.

Finally, you as a human have another curious quirk which no other animal possesses. Just when you get it, we cannot tell. We can't even say that it is really inborn. At any rate, you pick it up very early in life; namely, the tendency to imitate. Place even a monkey in one of our puzzle boxes with another monkey that knows the trick of getting out and it doesn't help a bit. Monk number two can demonstrate 100 times before his brother, but the first one has got to learn it all by himself, just as if the other weren't there. As one chap puts it, "Monkeys don't monkey." Your dog is just the same in this or any other situation. He will not imitate another dog.

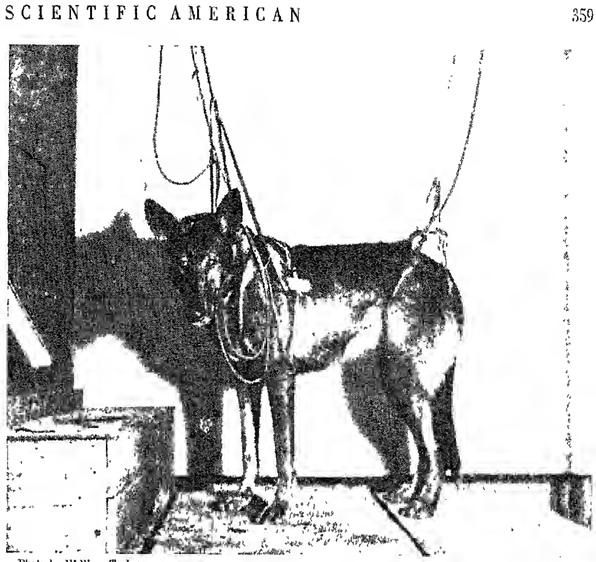


Photo by William T. James

**This dog is standing in the animal room before the food table. Food is presented with a conditioning signal. Cup on cheek records conditioned saliva**

The human is totally different. Directly Billy sees Johnny pulling the cat's tail, lighting matches, or turning on the gas, the world just isn't worth living in until he can do exactly the same thing. The adult human is even more of a "copy cat," although perhaps a little more discreet as to what he copies. When learning to sew on a button, drive an auto, or manufacture synthetic rubber, you watch your instructor carefully, then do your best to imitate him, correcting any minor mistakes by the trial and error process. The fact that your instructor may be a book in no way alters the argument. One authority in animal psychology says that an ape has the brains and the throat mechanism to learn speech if he would only imitate the human instructor. But friend Chimp isn't interested. (Perhaps he has observed the fate of many humans and decided that he'll save himself a lot of trouble if he just says nothing, in the first place.)

THESE three factors—language, ability to think in the absence of an object, and the tendency to imitate—give man an enormous advantage over your dog or any other animal in trial and error learning. On the other hand, the dog possesses certain advantages over the human which, on first sight, give the appearance of greater intelligence. These are largely matters of the sense organs. For example, a dog's hearing is remarkably acute and his sense of smell simply unbelievable. He will pick up the trail of a fox, circle around for a minute and always start in the *right* direction. How can he possibly decide which way that fox was going? There is only one way. He back tracks 50 feet and picks up the difference of intensity in that scent, possibly ten hours old, over this short stretch of ground! Then he's away. You can't detect the slightest scent to begin with, let alone those tiny differences on which the dog must determine his activity. His sense of hearing is almost as keen, so bear in mind that much of your dog's performance may be just good ears and nose. This is not the same as intelligence.

The principle of the conditioned reflex, together with trial and error learning, explain a lot, but the picture is not complete. Only recently we have discovered a third broad principle, that of Gestalt learning, which, together with the first two, seems to cover this field of learning pretty thoroughly. Gestalt psychology is not so easy to grasp. It stresses the *whole* situation and raises a strenuous objection to the so-called "morcelment of the environment," so common with other schools of thought. In the actual field of learning it states that, given a certain intelligence, the whole picture or Gestalt will tend to complete itself. The problem, as it were, solves itself without any of this nonsense about conditioned reflexes or trial and error. But, as we mentioned before, you must have an animal of high intelligence if you wish to demonstrate Gestalt learning. Otherwise the first two principles are sufficient.

For example, let us suppose you place a chimpanzee in a room. From the ceiling you hang a banana, but put it well beyond his reach. There are also two wooden boxes in the room, and you take care that friend chimp is hungry. The latter point is not difficult, because he

runs a perpetual appetite, but the way he gets that banana is totally different from anything so far described. He doesn't raise a fuss but sits down, and, as it were, scratches his simian head. Then he places the first box under the banana, decides it isn't high enough, piles box number two on top, jumps on his pedestal and gets his reward. Or suppose we put him in a cage with a banana outside and well beyond his reach. In the cage with him are two sticks, one of which will fit into the other, thereby giving a much longer reach than either one by itself. He first tries to hook in the food with stick number one, finds it isn't long enough, lengthens it with the second and gets the object.

Just as instructive are the mistakes he may make, for there are degrees of intelligence in apedom. The performances just described were by a very bright chimp, but suppose we now get a "chump." An experimenter hung the banana close to the wall but high up. The chimp—in this case a chump—looked at it, brought up box number one and discovered it wasn't high enough. Then he got an idea. He solemnly lifted the box from the floor a couple of feet and placed it against the wall. Then he let go and raised a howl of woe when the box, instead of sticking there, came down on his toes. But it was an idea. Placed in the cage and confronted with the two-stick problem, he was equally brilliant. He reached with the first stick, but couldn't make it. Then he lay the first stick in front of the cage and poked it out with the second until he touched the banana. Contact established, he tried to hook in the food, and registered profound disgust when it didn't work. But again it was an idea, even if half-baked.

You will note that in this Gestalt learning the entire situation is presented to the animal with all the factors necessary for solution *in plain sight*. Under these circumstances and in the presence of the high intelligence of the chimp, "the situation tends to complete itself." To be sure, the chump didn't do so well, but his were "clever mistakes" and far superior to any performance your dog could produce. He really showed "insight" into the problem, which fact has led to the further term "insight learning" as describing this performance. Apparently it is confined to man and the other primates, although there is certain evidence that other animals can develop along these lines. These three broad principles — conditioning, trial and error, and Gestalt learning—pretty well cover the field of learning. But we haven't answered our original question.

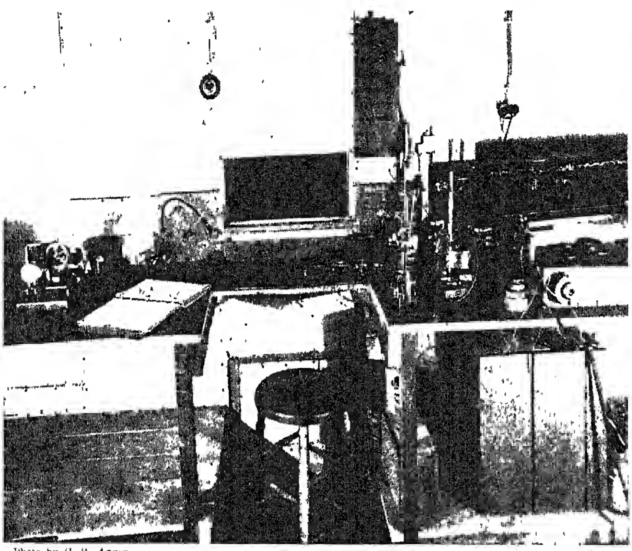


Photo by C. S. Apgar

**Experimental room of Conditioned Reflex Laboratory, Cornell Anatomy Farm. Animal is observed through glass window in center and kymograph makes records**

Can your dog think? The general answer would be "No." We would never deny his ability, or that of any other animal, to learn. He learns better than most. Here even the human, if forced to run a maze under the conditions we use with a dog, has little if any superiority. But we use the word "think" with a somewhat different connotation. We generally mean the use of language symbols in the solution of a new situation.

One scientist demonstrated this very nicely. He brought up a baby chimpanzee with his own little boy. They lived together as brother and sister. It is most interesting to note that, up to the age of 18 months, the baby chimp was superior to her human brother in practically all the intelligence tests used. Then the human, as was to be expected, took a mean advantage—he learned to talk. From then on, the poor little chimp didn't have a chance.

Perhaps we can illustrate this human advantage even better from our own article: When *you* face *your* skunk situation, you at once resort to symbols or language for its solution. When you say "skunk" to your neighbor, you use a symbol which means something very definite to him. When he replies "shotgun," that symbol is significant. When he says, "Get my shotgun from the barn and meet me at the henhouse" he uses a whole string of symbols, not only for objects but for lines of activity, yet you have no difficulty in following him. As you have never before used his make of automatic shotgun, he demonstrates. In two minutes, through your peculiar human knack of imitating, you have learned all that is necessary about the gun. Then, as if all this did not give you sufficient advantage over your dog, you use "insight" when you face the actual situation. You size up everything as a whole and act accordingly.

WITH animals we have to exercise the very greatest of care with reference to incidental cues. Perhaps this was never better illustrated than in the case of the Horses of Elberfeld or of Clever Hans. These horses astounded Europe by their ability to calculate, tapping out the right answer to intricate mathematical problems with their hoofs. Several very able scientists were completely deceived. Finally, it was discovered that the horses could give the correct answer only if their trainer were present and knew the answer in question. The animals watched him very closely and would always stop tapping on a very slight, possibly unconscious, sign on his part. In some cases the owner is perfectly honest.

Such has been the case in many animal experiments conducted in the laboratory. We would carefully train the dog to select a red light in the left corner of the room when we sounded one note on the piano, a green light to the right on another note. Then, after wasting a couple of months on the problem, we would suddenly discover that friend dog wasn't even listening to the notes; he was watching the experimenter, who would look toward the desired corner on the given signal, thus informing the dog where to go. The rule now is that, in good dog experiments, the human must be out of sight and sound.

IN conclusion, we can only say that the dog thinks on a very low plane, if at all. Perhaps he does use past experience to solve new situations, perhaps he may understand a few simple symbols, but his abilities here are so inferior to those of the human that we are almost entitled to say, for all practical purposes, that your dog is a non-thinking animal.

# OUR POINT OF VIEW

### Does It Condition?

PARASITES seem to be the rule rather than the exception in every line of endeavor. Let an honest development spring from the laboratories and immediately a group of imitators come forward with cheap, unreliable merchandise to foist on the unsuspecting public. The relatively new development of air conditioning is an excellent case in point. No sooner had the public been informed of the advantages which accrue from air conditioning than a crop of cheap "air conditioners" appeared on the market to be bought eagerly by thousands looking for the benefits of conditioned air without the expense.

Most of these so-called air conditioners consist of nothing more than a fan built into some sort of a fancy cabinet and selling for about three times the value of the materials used. Occasionally they contain a method of vaporizing water to increase the humidity of the room. In any event those selling at a ridiculously low price—ridiculous in the face of the necessary cost for true air conditioning units—have little or no more value from the standpoint of air conditioning than a fan.

In view of this situation it is encouraging to learn that the Federal Trade Commission has recently stepped into the picture and verbally spanked one manufacturer of an air "purifier" and circulating device. The Commission has ordered that this company discontinue the use of the words "air conditioning" from their advertising, as well as the statement that the device ". . . accomplishes cooling effects of 8 to 10 degrees lower temperature in summer."

If only this stipulation can be extended to curb the other parasites in the same line, one more of our thriving industries will be freed from a handicap which inhibits the growth that is rightfully its own.

### Gas Hazards

WHEN 455 pupils of a public school are killed in seconds in an explosion of gas, it is but natural that, quickly, other schools are inspected to learn whether hazardous conditions exist elsewhere. After the New London, Texas, disaster, that is what actually happened. In a sense, such inspections were an admission that "perhaps we have been lax in our building construction or in safety precautions."

It seems that the Texas tragedy was only partly due to human error. In any case it was unforeseen and unpredictable. Dr. David J. Price, explosion expert of the Bureau of Chemistry and Soils, gives it as his opinion that "the explosion was due to an accumulation of combustible gases in an open area underneath the first floor of the building by a flash from electrical equipment . . ." To prevent similar explosions, he urges the use of malodorants, gas detectors, special supervision and inspection, strict adherence to the code for electrical wiring, elimination of dead storage space where gas might accumulate, and adequate ventilation throughout schools and public buildings.

One further element entered into the Texas explosion. In an oil country where the very air reeks of oil, no one would detect, by smelling, a dangerous accumulation of gas. This fact serves to emphasize Dr. Price's first suggestion: the necessity for using malodorants in gas. Such chemical stenches do not interfere with the burning of the gas nor do they smell except in the unburned gas. If such doctored gas leaks, its foul smell would immediately call the leak to the attention of persons in the vicinity long before a dangerous amount could collect. Addition of malodorants such as, for example, ethyl mercaptan, would cost, it is claimed, but 500 dollars for each billion cubic feet of gas used. Nine thousand dollars would, therefore, have imparted an odor to the 18,000,000,000 cubic feet of natural gas which was used in this country in 1929. Since natural gas is practically odorless and also more explosive than artificial gas, such use of malodorants is particularly important in some parts of the country. California, for example, has already decreed that all gas supplied to homes and factories be given such an evil smell. Other states have followed suit.

To us this use of malodorants in all gas—whether for schools, factories, or homes—is so inexpensive a precaution as to make us wonder why it has not been made compulsory over the nation. When such a small amount of money may avert any number of tragedies, there is no excuse for past failure in this regard other than public ignorance and the apathy of those "in the know."

### Telepathy Comes of Age

THE entity called science, with its scope limited to the more restricted sense of the term, is the sum of several constituent sister sciences such as mathematics, astronomy, physics, geology, botany, zoology, anthropology and psychology. Some of these, such as mathematics and astronomy, physics and chemistry, are generally regarded as the more "exact" sciences, while others, such as anthropology and psychology, have not usually been so regarded.

If this has been true of the science of psychology, and if psychology was once looked at as something of a poor relative, then much the same kind of thing has in turn been equally true of one particular corner of psychology, the corner sometimes designated as "psychic science." Indeed, psychic science has long suffered the disowned status of Orphan Annie in the psychological and therefore the whole scientific world. If the reader will examine a textbook of psychology and look for the psychic science dealt with in it he will discover almost what the readers of Dr. Johnson's famous book found under the chapter on the snakes of Ireland—a blank. For this situation the psychic world has itself to blame; it too often wanted to play the game without rules or else to change the rules during the play. Scientists shied off. Many who didn't were burned.

Despite this unfortunate situation, a few scientific men did stick to Orphan Annie through thick and thin, determined not to quit merely because the conditions were most trying. One of these was the late Walter Franklin Prince whom some psychologists thought perhaps a bit too willing to believe, but psychics significantly regarded as hard and most unaccommodating. Another is Dr. J. B. Rhine of Duke University and, after some years of patient presentation of evidence in one small corner of psychic science—that pertaining to telepathy or extra-sensory perception—he is now winning a definite place in the sun for that science. Continuing researches previously described by Dr. Prince and by himself in this magazine, his work has now been checked up by psychologists in a number of leading universities and to their surprise they have found he was right—there actually is such a thing as telepathy and evidently even clairvoyance. The evidence looks like proof. With this excellent start a new journal has been inaugurated, the *Journal of Parapsychology*, and we take this opportunity to congratulate its editors, Dr. William McDougall and Dr. J. B. Rhine, on its excellence. This new journal will deal with psychic research—though for the present, only with those aspects of telepathy and clairvoyance which can be studied by actual experiment.

# MINUTE MEN OF THE

By ANDREW R. BOONE

A doctor receives his goggles and smoke mask preparatory to penetrating a forest-fire line where he will render first aid to the fighters

Brought in on an improvised stretcher, a fire fighter receives first aid. Note fire truck in background

MIDNIGHT on the fire line in the Malibu Mountains of southern California . . . 2000 weary, begrimed men battling ceaselessly . . . fire wardens endeavoring to halt the conflagration which already has burned over 30,000 acres . . . first-aid men backing up the fire fighters . . . doctors and nurses setting broken bones, sewing up cuts, swabbing inflamed eyes.

Two men stand beside portable short-wave radio sets, eyeing long lines of injured men. At the rim of Corral Canyon, almost within arm's reach of the blaze, Spence Turner, chief fire warden for Los Angeles County speaks into a microphone:

"W6LHB calling W6AEM. . . . W6LHB calling W6AEM."

Six miles distant, deep in Corral Canyon, safe at the base hospital from immediate path of the blaze, a second voice goes on the air.

"W6AEM . . . this is Nolan. How are things going?"

"Pretty hot."

"Any bad ones?"

"We've treated 312 moose, eleven rabbits, one wild horse, two antelope and 98 elephants at the advance stations."

As the fire warden, speaking through a portable, short-wave radio unit at the fire front, completed his report, Dr. Frank G. Nolan, head of the medical minute men who back up forest-fire fighters in California, turned to his code book.

"We've treated 312 burned eyes, 11 lacerations, one fracture, two back injuries and 98 body burns," was what Turner had told him. Injuries of various types are reported as animals to prevent misinformation "leaking" over the air.

All along the fire lines small field hospitals, staffed by trained, volunteer first-aid men, attended to minor injuries as the fire fighters beat back at the searing flames. Physicians and surgeons held their posts at a base hospital, a few miles removed. During the days when the Malibu fire raged, 2000 injured men were treated at six dressing stations and one hospital, most of them being sent back within an hour to take up their work.

Within 30 minutes after an alarm is received, these minute men of the forests are racing toward a forest fire, no matter where in California the outbreak may occur. Officially, they are known as the California Forestry Medical Corps. At all times 300 doctors stand ready to move in case of disaster, whether fire, flood, or earthquake. With them go first-aid and rescue units and trained radio men, each one with his own special job to do.

WHEN a blaze starts, even in an inaccessible mountain area, forest rangers move swiftly for medical aid. In the San Bernardino Mountains a ranger saw wisps of smoke, then flames, break into the sky the other day.

"Fire in Cajon Pass," a lookout reported by telephone to headquarters. "Spreading rapidly."

The forester consulted his maps. A brisk wind and sun-parched slopes would carry the fire quickly through the brush and trees. He ordered his aides to call out 900 men, then turned to the telephone and placed a call to the Alvarado hospital in Los Angeles, 60 miles distant.

A gas torch starts a backfire in order to head off a large conflagration

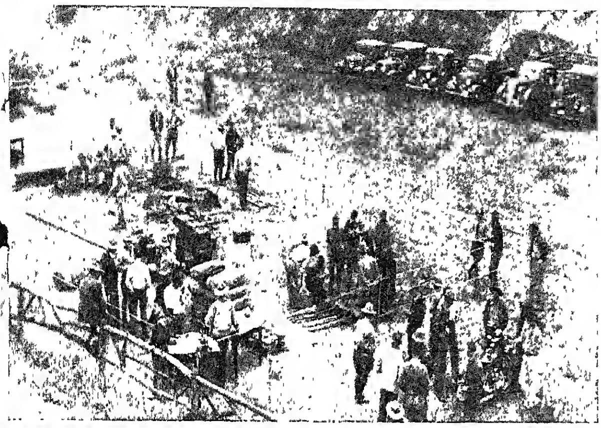
"We need five doctors and 10 first-aid men," he said.

Within five minutes the dispatcher at the hospital called five doctors, ordered an automobile from the sheriff's office, called the director of the first-aid unit, and 28 minutes later the last of the 15 men was speeding down the highway to the outbreak.

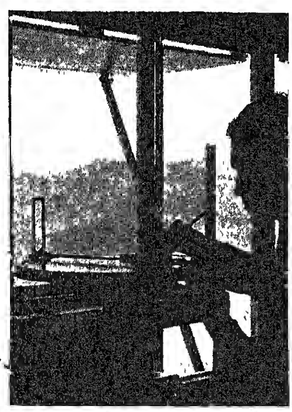
First-aid workers and doctors at the fire line often have to plunge through smoke to reach many victims, and must therefore be able to see at all times. To meet this condition, Dr. Nolan has invented a combination water goggle and

# FIRE LINE

**Volunteer Doctors and First-Aid Men ... Use Short-Wave Radio Communication ... Special Goggles and Smoke Masks ... Keep Up Morale of Fire Fighters**



A base hospital and supply depot located at a safe distance behind the line of a large forest fire



The Osborne fire finder in use to locate exactly the position of a fire. This information is then transmitted at once to the Forest Rangers

Mopping up a burned-over area often results in burned feet that require immediate medical attention

mask. Water is contained within the rubber mounting of the lenses and sweeps across the inner side when the wearer shakes his head, thus cleaning the fogged surface. The mask removes both smoke and acrid fumes from the air as it is breathed.

As soon as first-aid workers reach the scene of a forest fire, word is passed along that medical attention awaits anyone who needs it. By this means, the fire fighting crews are kept at peak efficiency so long as flames lick at trees of the forests.

Of course, only the larger fires make newspaper headlines and require the presence of medical minute men near "the front." Good generalship requires that plans and strategy be worked out in advance of the enemy's invasion. Most forest fires are being put out this spring before they become large enough to make next summer's scare heads.

Foresters in the National Forests have for several years been conducting what they call "hazard" study. Fire reports have been analyzed to find out what happened, and how conflagrations could have been prevented. All types of forests were studied to learn what would happen if a fire started, and how quickly the fire must be reached to prevent it from spreading. This resulted in the so-called "hour control" plan of the forest service. Each section of the forest was laid off in zones, and the hours or minutes necessary to get at a fire in that particular forest zone were determined.

ANOTHER part of advance planning for the fire season is carried out each year by the District Rangers and Forest Supervisors. Each Forest Ranger makes a fire plan for his district every spring. Lists are prepared so that men and supplies may be quickly mobilized by telephone in emergency. Tools are organized, emergency rations kept on hand, transportation arranged for, fire fighting forces selected and trained.

When the humidity begins to drop and woods get dry, the first line of defense is thrown out—guards, patrolmen, and lookouts—and located at strategic points to check the first invasion of the enemy. The detection system then begins to function. Lookouts on high mountain peaks constantly scan surrounding timber for the first puff of smoke. They use an instrument known as the Osborne fire finder. The fire finder, when sighted at a fire, gives a figure known as the "azimuth reading" which enables the ranger in the valley below to locate the fire on his map.

When a fire starts, usually it is spotted by one or more lookouts. The location, size, and other information about the fire is telephoned to the ranger. A smokechaser with tools, emergency rations, and a portable short-wave radio outfit is dispatched to the fire, immediately. He puts it out, if possible, and reports back by radio that the situation is in hand. If it is more than a one-man job, he radioes back for reinforcements. These portable short-wave radios have been developed by the Forest Service during the past few years, and have been a valuable addition to the protection equipment. A smokechaser's set weighs 14 pounds complete, and receives and transmits.

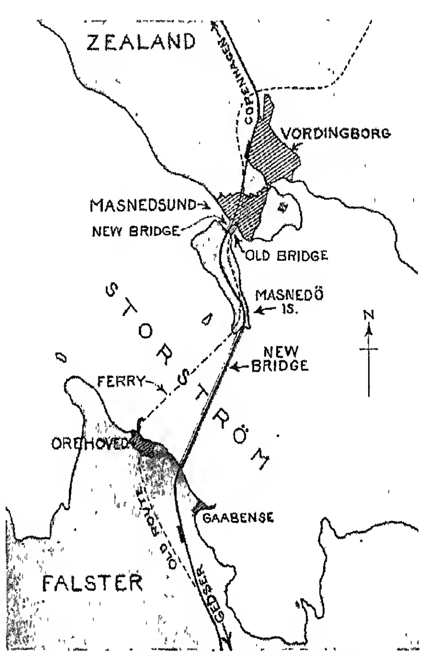
In spite of careful planning and execution some fires get away. Combinations of wind, weather, and human carelessness may make it impossible for fire to be put out while small. Occasionally a big fire gets away which is costly in money, time, and destroyed resources. In most cases, however, forest fires are halted before their destructive flames spread far afield. But when a big blaze does get well underway, all the forces of fire-fighting science rush into the front lines to beat back the attack, while the medical minute men back them up in their untiring efforts to vanquish the red enemy.

# DENMARK BRIDGES

By R. G. SKERRETT

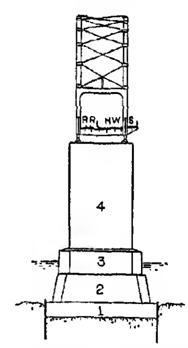
DENMARK, with her Diesel-motored "Lightning Trains" and her splendid new bridges, is effectually reducing the handicap laid upon her by nature. The kingdom embraces more than a hundred islands, great and small, that have made the problem of rapid transit a difficult one; and Denmark is a thoroughly progressive country.

To cross her numerous domestic waterways as well as the water gaps that separate her from neighboring nations, Denmark has developed fleets of typically modern train ferries. The largest and finest of these link opposing shores at strategic points and especially along her rail trunk lines that are tributary to ports served by steamships and rail connections leading to the capitals of Europe. But the best of train ferries are slow compared with express trains, and every unbridged water gap entails delays and possible inconvenience, particularly when thick weather hampers the navigator. Accordingly, within the last few years, Denmark has embarked upon a program of bridge building, and the aim is to abandon the use of ferries wherever it is economically practicable to substitute steel spans. The latest and most noteworthy of these structures is the Storström Bridge, which was opened to traffic last December.




Site of new bridge and the old ferry it supersedes

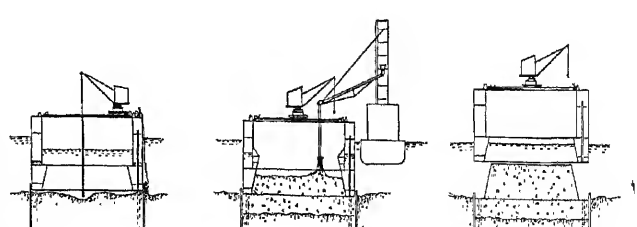
THE Storström Bridge is the longest bridge built to date in Europe, and it spans a body of water that lies along the important and much traveled route between Copenhagen and Berlin. The Storström, itself, is between the Island of Zealand, on which Copenhagen is situated, and the more southerly Island of Falster. The Storström, to be exact, flows between Falster and the small Island of Masnedö; and the latter is separated from Zealand by a narrow waterway known as Masnedsund. Masnedö, therefore, provides the northern approach to the Storström Bridge, this little island having been for years linked with Zealand by a low bridge that has served rail and other traffic. Before the Storström Bridge was available, a train bound from Copenhagen to Berlin, via Warnemünde Germany, had to board a ferry at Masnedö and again shift to a steamer at Gedser, on the southern tip of the Island of Falster, making the two transfers within a distance of less than 30 miles. With the Storström Bridge in service, there is now only one such transfer, and that is at Gedser for the 2½-hour run across the Baltic to Warnemünde. The saving in time is substantial and, no doubt, deemed sufficient to warrant an outlay of approximately 6,120,000 dollars.




Section of the Storström Bridge showing railroad, highway, and sidewalk, and the four separate sections of one of the piers. Base slab is surrounded by a ring of piles

The Gedser-Warnemünde run was established in 1903, and the volume of traffic has since increased so greatly that the Danish government decided in 1932 to build the Storström Bridge in order to meet the needs of passenger and freight service. Over the same water route thousands of motorists enter and leave Denmark annually, the greater number doing so in the summer-time. The Storström Bridge has accommodations for both rail and motor-vehicle traffic, and is furthermore provided with a broad sidewalk for pedestrians and bicyclists. Denmark is over-run with domestic and visiting cyclists.

Work on the Storström Bridge was started in the spring of 1933, and its completion was contracted for by the close of this year. Through a combination of skilful engineering and the employment of novel and ingenious construction aids, the bridge was finished and turned over to the Danish State Railways 12 months sooner. From end to end, the crossing has a length of 10,532 feet, and its deck has a width of 49 feet, which affords space for a single railway track, a vehicular roadway more than 18 feet wide, and a sidewalk nearly nine feet wide. Of the three fixed spans over the channel, the middle one has an



The floating caisson permitted open excavation of the pier bed. Then concrete for the base slab and first section of pier was poured, and caisson was floated away

# THE STORSTRÖM

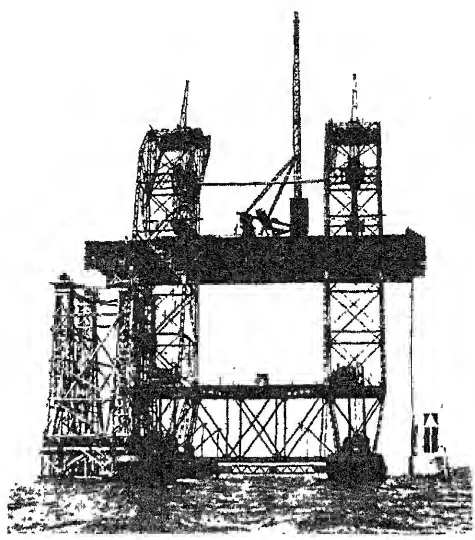
## Longest Bridge in Europe . . . Speeds Trains Between Copenhagen and Berlin . . . Unique Floating Caisson Pier Forms . . . Completed Ahead of Time

under clearance of 85 feet, which is ample for any of the 15,000 vessels that thread the waterway regularly.

The bridge is supported on 49 offshore piers that have their footings below the surface of the clayey water bed at a maximum depth, for the heaviest of the piers, of approximately 15 feet. Along the line of the bridge crossing, the Storström ranges in depth from an average of 26 feet to as much as 46 feet. The rise and fall of tide rarely is as much as three feet, and tidal currents have a velocity of 4.75 miles an hour. Fairly strong winds and large waves occur at times. The builder of the substructures had, however, to make provision against heavy floating ice; and that fact influenced the design and the method of placing the pier bases where the structures emerge from the water.

With 49 piers to be formed of concrete and to be erected from the water bed upward, the majority of them being identical in their dimensions, it was realized that much time and money could be saved if they could be poured in a few forms that could be used repeatedly as pier base after pier base was constructed along the line of the crossing. These pier bases reach from their footings in the bottom of the Storström up to an elevation of approximately 10 feet below the normal surface of that waterway. For this repetitive work, the contractor devised a type of caisson, built of steel, that could be floated to each pier site in succession, sunk to the bed of the Storström and unwatered so that the workmen within it could excavate, in the free air, the area for the massive base slab of the pier foundation. With the excavating done, the concrete was poured within the caisson up to the prescribed elevation; and when the concrete had set sufficiently, the caisson was freed, again made buoyant, and allowed to float high enough to clear the top of the pier base. This was the procedure followed where the bottom clay was of a firm nature at the pier site. The caisson was made to sink by loading ballast tanks with water, and, when its work at a pier site was finished, it was given buoyancy by discharging the water ballast by pumping out the tanks.

Where the clay was firm, a ring of piles was driven around a periphery somewhat smaller than that of the bottom of the caisson so that the caisson could rest on the tops of those evenly spaced and level supports, which projected slightly above the surface of the water bed. Next, steel sheet piles, hung like an apron around the outer surface of the caisson, were driven deep into the clay, snugly around the bottom of the caisson and extending up above that level only a few feet. That enveloping wall was then made watertight at its top by forcing flexible fiber calking between the piling and the outer plating of the caisson. It was then possible to pump out the enclosed area so that the workers could do the necessary excavating preparatory to placing the base concrete in the dry. With that finished, and the concrete poured, the caisson was released and stripped from the concrete with the aid of powerful jacks—the caisson having been made buoyant and water having been admitted into the area enveloped by the caisson. The caisson was then available for service at another site.

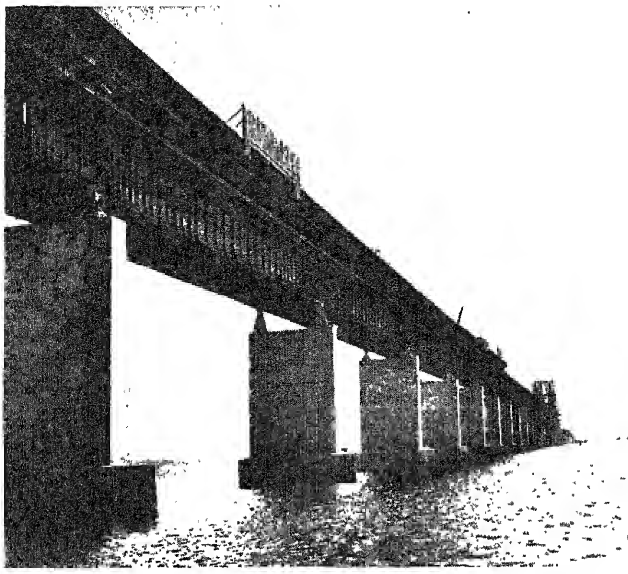


The 500-ton floating crane used to move a fully assembled large girder from land to its final position in the bridge

Where the water bed was not of firm clay, the procedure at a pier site was somewhat different. A caisson was sunk and brought to rest after slightly penetrating the bottom material. Then a cofferdam, formed of steel sheet piles and suspended from within the caisson, was driven into the water bed closely subscribing to the interior walls of the caisson. The water bed so enveloped was next excavated for the basic slab—the concrete slab being placed under water and made thick enough to seal the caisson. It could then be pumped out in order to pour the remainder of the subaqueous structure in the dry, the submergible caisson serving as in other cases as a form for the pier base. When that work was completed, the caisson, which was made buoyant by pumping out the water ballast, was shoved free with jacks and allowed to mount surfaceward and clear of the pier base. The caisson was then again available for service at another pier site.

EACH pier base so constructed rose to a level of 10 feet below the surface of the water and had to be surmounted by a base section extending from that level up to 10 feet above the water—the pier shaft rising from that level to the height required for the support of the steel spans. The savings effected by using mobile caissons would have been lost if separate forms had been built in which to pour the concrete for the intermediate base sections, that are half underwater and half above, and there would have been the hazard of ice or storm waves damaging or sweeping the forms away. Therefore, these special sections were constructed on shore and took the form of reinforced-concrete caissons that had sufficient buoyancy, after launching, to be floated to their prescribed sites and there loaded with enough water to cause them to sink on to the tops of the submerged pier bases.

These caissons, 20 feet in height, were



One of the two long approach sections of the new bridge across the Storström. The channel spans are to be seen in the middle distance, the island beyond

elliptical in plan, and their outer surfaces are faced with granite blocks embedded in the concrete of the caisson walls. They were really vessels with open-top compartments into which water ballast could be pumped to destroy their buoyancy. The contact surfaces of the underside of one of these caissons and that of the top of the submerged pier base were bonded by a heavy intervening coat of asphalt. After that union was made, the caisson was filled with concrete to transform it into a solid structure.

These caissons were poured on shore in forms that could be used repeatedly, and the caissons were launched and towed to their offshore positions whenever conditions were favorable. Each caisson was moved to its given position between two barges that held it nicely centered until set upon its proper pier base.

THE steel superstructure of the Storström Bridge consists of 47 approach spans and three longer and different spans immediately above the channelway. The approach spans are of the cantilever type, and those spans are alternately anchor arms or suspended spans, their lengths being either 190 feet or 204 feet. The three spans over the channel way are stiffened tied-arches. The two side spans are each 340 feet long and the center span has a length of 450 feet.

The basic steel structure throughout the bridge is composed of two parallel massive plate girders standing 12 feet high, separated either 24 feet or 40 feet, the latter being the case at the channel spans; the two lines of girders are tied together by an extensive system of intermediate bracing. On top of the girders are laid the transverse beams that sustain the floors or beds for the railroad, the motor roadway, and the sidewalk. The reinforced-concrete highway and sidewalk are a single structure, while the reinforced-concrete floor for the railroad is an independent structure upon which is placed ballast that carries the cross ties and the rails. At each shore end, the suspended structure rests upon a massive concrete abutment; from those terminal points the bridge descends to the ground level by long approach ramps that have a gradient that reaches a maximum exceeding 6.5 per cent.

On the Island of Masnedö, the ramp takes the form of a great "S" which links the Storström Bridge with a new swing bridge across the Masnedsund. The latter bridge is a part of the Storström Bridge undertaking, and is, therefore, contributive to time-saving. The Masnedö Bridge has a total length of approximately 606 feet and is made up of five spans. The more modest depth of the Masnedsund, its sheltered course, and other circumstances, made the work of building the supporting piers and the steel superstructure much less difficult than in the case of the bridge across the neighboring Storström. Nevertheless, both the steel workers and the concrete workers made rapid progress by reason of expert guidance and the employment of time-saving equipment.

THE substructures were built for both bridges by the well-known Danish firm of Christiani and Nielsen; all the steel material and the fabricated members of the bridges were furnished by Dorman, Long & Co., Limited, England, who also erected the superstructure. This latter concern devised apparatus by which entire assembled spans for the Storström Bridge could be moved bodily from a shore station and carried by a floating plant which could hoist those members to a suitable height and then lower them on to the sustaining piers. In short, numerous exceptional facilities were utilized by the contractors which set new standards in the design and construction of large bridges.

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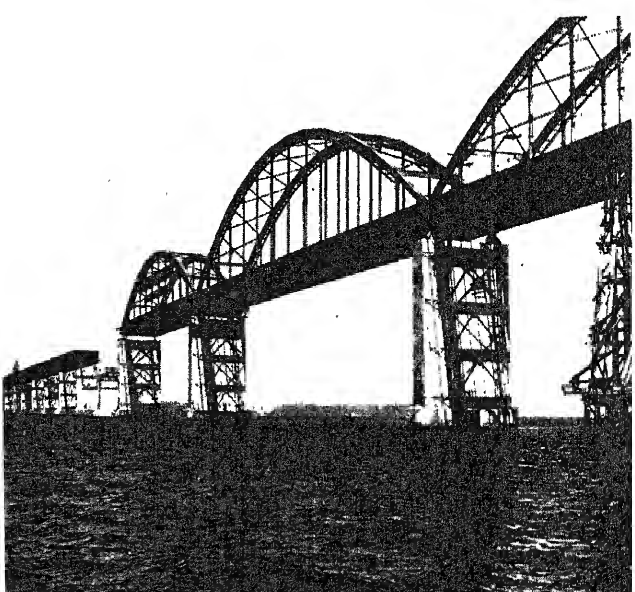
*Submarines—their function in present and future naval tactics—are discussed by Walton L. Robinson in a July article.*—The Editor.



Spans of the long bridge at the point where it crosses the deep channel for the numerous and relatively large ships that regularly pass between the islands

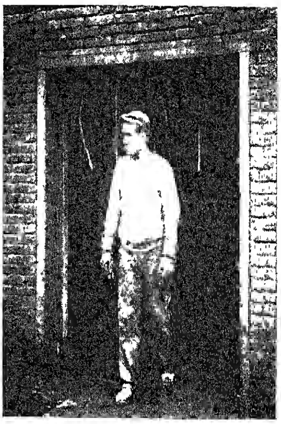
# SAFETY IN INDUSTRY

SAFE working conditions for employees are now considered to belong in the ABC's of operating efficiency by the country's more progressive industrial concerns. The pictures on this page show some of the many ways in which the Bethlehem Steel Company, one of the world's largest producers of steel, promotes safe working conditions among its workers. One of the important ways in which safety is promoted is by making working conditions as comfortable as possible, thus reducing the hazard that often has its origin in fatigue.

A pill when it's hot—but it's just salt and sugar, mostly salt. Since salt is one of the most effective antidotes to heat, steel workers exposed to intense heat keep comfortable by using pills which also contain dextrose, another heat combatant

Heavy steel plate guards surround grinding wheels. Suction carries dust away. Use of goggles and leather aprons gives added protection

Goggles for modern blacksmiths are of the strongest, toughest safety glass



Doorways adjacent to tracks of the Bethlehem Steel Company are equipped with "cat-tails" to remind of possible approach of engines

Automatic vigilance. This press operator wears wristlets; cords attached jerk his hands back if he negligently leaves either of his hands in the path of the descending punch

Operators of pipe welding furnaces are provided with "heat masks." The fine wire screen of these masks checks the heat by absorbing it, yet does not materially reduce vision

# Youth and Age in the

## A Problem That is Not so Simple as it Seems . . . Ascertaining Which Astronomical Events Have Followed Others, and Which Have Preceded Them

By HENRY NORRIS RUSSELL, Ph. D.

Chairman of the Department of Astronomy and Director of the Observatory at Princeton University. Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington. President of the American Astronomical Society.

SEVERAL members of the staff of the Mount Wilson Observatory have found entertainment and profit in discussing a question which is not so simple as it looks—what objects of astronomical observation, outside our earth, are there about which we can say with security: "This is of more recent origin than that?" By the terms of the problem the answer, like the verdict of a jury, for conviction, must be given only in cases where there is no reasonable doubt about the conclusion. Deductions from theory are admissible only when the theory is supported by so great and so consistent a weight of evidence that it has passed from the stage of hypothesis into that of general acceptance. By mutual agreement, too, certain obvious cases are excluded as trivial—sun-spots, solar prominences, clouds on Mars, markings on Jupiter, where changes in rapidly varying phenomena are observed day by day. In the same class come changes in comets —although the conclusion that, of two condensations in the tail, shown on the same photograph, the one farther from the head is the older, might be presented as grounds for a verdict, since it depends on the general law that such objects always move away from the head.

The strict constructionists of our group, however, have secured a unanimous decision that all such answers, based on directly observed motion, shall also be excluded as obvious. This cuts out the expanding nebulae around Nova Persei and Nova Aquilae, which might already have been rejected as cases of directly observed change, and also the slower motion in the Crab Nebula in Taurus, which is expanding at a rate which indicates that it may have been produced by a great outburst, like that of a nova, about a thousand years ago.

In this case the advocate of exclusion might raise the question of reasonable doubt, and inquire whether we can be *certain* of the conclusion just expressed. The opposing counsel may reply that the assumption that the observed motion of the nebular filaments has been uniform rests upon Newton's first law of motion, which we have every reason to believe to hold good unless some specific force is at work, and present evidence that no known forces of sensible magnitude will operate on diffuse material of this sort. If the exclusionist cannot specify any such force, his case is lost—for the assumption that some unknown force is at work must obviously be "off the record." The inclusionist may strengthen his position by remarking that outbursts leading to the ejection of nebular material have been observed to occur, so that this hypothesis is reasonable. But nevertheless he must lose his case on appeal, for it has been adopted as a constitutional principle that cases based on observed motion are to be rejected.

The great oval loop of nebulosity in Cygnus, which, by the same arguments, is approximately 100,000 years old, must meet the same verdict—though by this time protests may be made that the case has been thrown out on a technicality.

PASSING to the more interesting cases, which cannot be so simply disposed of, long and active discussions have brought out only a single irrefutable instance. Among the craters which strew the Moon's surface, there are a number of instances in which one crater cuts into the wall of another—interrupting it, while retaining its own symmetrical shape. This is circumstantial evidence, but of the most conclusive sort. We do not know how the lunar craters were produced—by volcanic eruptions, perhaps, or by impact of huge meteors, or by sinking of sections of the crust into a molten substratum—but, in any case, it is altogether reasonable that a later formation should cut into, and partly obliterate, an older one, and altogether absurd that the later disturbance should stop acting as it reached the edge of the old crater, and leave it intact.

The very numerous cases in which small craters are found on the floor of large ones may be adduced as also in point—though our opponent might here argue that it was possible that the small interior craters had been produced so shortly after the big one that the material was "still soft" and were therefore substantially of the same age. The writer, faced with this dilemma, would be inclined to take refuge in the famous Scotch verdict "not proven."

These lunar formations, however, are quite unlike any other material with which astronomers have to deal. They are much more akin to the subject-matter of the geologists, who have established an extensive sequence of relative dates on earth, independent of any evidence from fossils, or of the powerful recent aid of studies of radioactivity. Moreover, from the astronomical standpoint, they are unique. Were the surfaces of Mars or Venus covered with craters of the same size, they would be observable under the best conditions—and we do not find them. Mercury, if it were nearer the earth and observable under better conditions, might perhaps show them—but this is mere guesswork.

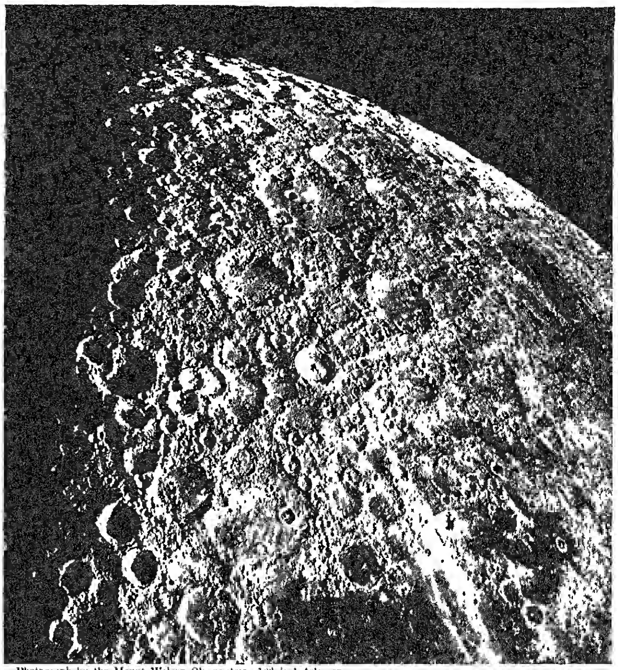
Outside this, the best case for the prosecutor who seeks for youth in the heavens is found among the comets of our solar system. There are a great many of them—a very great many. Apart from the returns of periodic comets which have previously been observed, three or four new ones, on the average, are discovered every year. Most of these are moving in nearly parabolic orbits and on the average thousands of years must elapse between their successive returns. No matter how assiduous the search, it would therefore be many thousands of years before terrestrial astronomers could complete the census of comets. There must be at least 10,000 of them, and may well be 100,000—or more, if we allow for those which do not come close enough to the sun to be visible.

Now a comet is the poorest of all celestial life-insurance risks. It may perish in a variety of ways—ceasing to be a luminous object, though not, of course, being annihilated. In the first

# HEAVENS

place, it is liable to changes in its orbit. The attraction of a planet, if it happens to pass near one, may speed it up, and send it away in a hyperbolic orbit, into the depths of interstellar space—never to return to the sun, and with an utterly insignificant chance of passing near any other star. The chance of so drastic a perturbation at any one return of a comet is small; but the change, if it occurs, is irreversible. (There is an off-chance, theoretically, that a comet ejected from some other star—if the stars have comets revolving around them—*might* pass through the solar system, but this chance is so exceedingly small that it can be neglected.)

Suppose that a comet, of period 10,000 years, stands one chance in a thousand of ejection at a given return. After 10,000,000 years a large number of such comets will evidently have suffered this fate—not all, because some of them will have had good luck. After 100,000,000 years very few of them will be left.



Photograph by the Mount Wilson Observatory, 100-inch telescope

**Just one inch below the top, and exactly in the center, is the large 150-mile lunar crater Clavius. This combines the two features mentioned by the author. Clavius is the largest depressed, mountain-ringed enclosure on the moon's face. Its walls average about 12,000 feet elevation above the interior portion. Other examples of similar kinds can be found if the photograph is studied closely**

NOW the evidence from radioactivity shows that individual terrestrial rocks are at least 1,200,000,000 years old. The most searching cross-examination has failed to shake or discredit this evidence, and it may be accepted as establishing this, beyond reasonable doubt, as a minimum age for the earth—and *a fortiori* for the planetary system.

In so long an interval, the loss of comets by deflection into hyperbolic orbits would be very serious. Those comets which had the longest orbits, and returned to the sun most rarely, would be in greater danger per return, since their velocities would be close to the speed-limit for escape, and they would be subject to additional disturbance by the attraction of the stars.

Apart from these dynamical vicissitudes, a comet is in danger of wearing out. The luminous gas and dust, which form the envelopes of the head, and give out practically all the light which makes the comet conspicuous, stream away down the tail, and are dispersed into the very depths of space. The process is as hopelessly irreversible as anything known to science. Each new apparition draws anew upon the resources of the head, which must be limited. Halley's Comet, during the last 2000 years, has been seen to grow 26 long tails. If it has been returning to the sun in its present orbit for the last 1,000,000 years, it must have grown 13,000 successive tails—which is not to be dismissed as impossible. But in 1,200,000,000 years it would have had to grow 15,000,000 tails—which appears to be too much to expect of one comet.

It is highly probable, then, that Halley's Comet has not been moving in its present orbit for so long. It is entirely possible that until a relatively recent date its orbit did not approach the sun near enough to start the process of tail formation and that it has been diverted into its present path by planetary perturbations. At present, its orbit does not pass near those of any of the large planets; but this again would be expected as the result of the cumulative action of small perturbations. There are many other periodic comets—several with periods about the same as Halley's—but they are all inconspicuous.

It is tempting to suppose, therefore, that they have been in their present orbits longer, and are nearly worn out. But, though this is entirely possible, and, indeed, plausible, there is no sufficient proof to establish it beyond a reasonable doubt. For example, the other comets may have been smaller, or poorer in tail material, to begin with.

Under the strict limitations which we have accepted, it cannot therefore be asserted that Halley's Comet *is* younger than the others, though it well may be.

The question whether the existing system of comets, as a whole—the sun's second family, as Chamberlin well called *it*—is as old as the first family, the planets, is the most doubtful that comes before our court. If we should assume that the processes of planetary perturbation and tail-formation have been going on as at present during all this vast interval, and should calculate back, step by step, we would find an ever-increasing swarm of bigger and bigger comets. Though numerical estimates are very difficult, even conservative assumptions lead to so great an initial number of comets as to be absurd.

Bobrovnikoff and others have argued, from similar premises, that the present family of comets must have been picked up by the sun much less than 1,000,000,000 years ago—perhaps when the solar system passed through some nebula. This suggestion is still speculative; but the general arguments that the cometary family is younger than the planetary are strong, and, if the question whether this is true without a reasonable doubt should be put before a group of astronomers, the decision would probably be by a close vote in which the individual convictions of the judges inevitably had weight.

Among the stars, it seems impossible to find a decisive case. If we knew more than we do now about the sources of stellar energy, we might have something to say; but, at the moment, there appears to be no sufficient evidence for a verdict.—*Mt. Wilson Observatory, April 1, 1937.*

# SCIENTIFIC DETECTION

By THOMAS HAYES JAYCOX
"Lie Detector" Operator,
Police Department, Wichita, Kansas

BACK in biblical days, when Moses chiseled the Ten Commandments on tablets of stone, a field of endeavor was opened that was to reach near perfection some 3400 years later—the detection of lies. That 9th Commandment—"Neither shalt thou bear false witness against thy neighbour"—was probably the most frequently broken then; it is the most broken now. Consequently, truth-loving people devised means of ascertaining whether or not the spoken word was fact or falsehood. They learned that attempted deception is usually accompanied by certain visible physiological changes such as pulsations in the throat, blushing, eye squinting, apparent dryness of the mouth and lips, and many other manifestations. The ancient Chinese required their suspects to chew rice while being questioned, and then spit it out for examination. If the rice were dry the suspect was presumed to be guilty because his tension of guilt was supposed to cause a cessation of the salivary gland secretion. In India the movement of a suspect's big toe was supposed to indicate deception.

Not always, however, have investigators depended entirely upon the physiological reactions. History, in the detection-of-deception field, records some amusing, yet effective psychological tests. Probably the most outstanding of these among the ancients is attributed to a crafty Hindu prince who used the superstitiousness of his subjects to catch the guilty. Whenever a crime was committed within his jurisdiction the Prince sent his investigators into the field to round up all the suspects. They were gathered into one large chamber in his palace and instructed to stand against the wall with their hands behind them. They were told that in an adjoining chamber was a sacred ass who would bray loudly when his tail was pulled by a lying person. They were further instructed to proceed, one at a time, into the chamber and grasp the tail of the guilt-detecting ass, and then return to their original positions.

EACH superstitious native took his turn, went alone into the chamber with the supposed supernatural donkey, gave the tail a pull and then returned, hands behind him, to his original position along the wall. When each of the group had been into the chamber and the donkey had not brayed, the Hindu prince ordered all suspects to extend their hands in front of them for inspection. A quick inspection showed that only one suspect had emerged from the donkey's chamber with clean hands—the guilty one. The Prince had dusted the donkey's tail generously with black powder before the test, and those who grasped it soiled their hands!

Such tests worked very well with a superstitious people, but in our modern complex society they would be worthless.

Back in the 16th Century, Benvenuto Cellini, Italian artist, metal worker, and sculptor, recorded in his autobiography the following, concerning his musician father who had destined his son for the musical world and attempted to thwart his inclination for design and metal work: "I was ill about two months during which time my father had me most kindly treated and cured, always repeating that it seemed to him a thousand years till I got well again, in order that he might hear me play a little. But when he talked to me of music with his fingers on my pulse, seeing he had some acquaintance with medicine and Latin learning, he felt it change so much if he approached that topic, that he was often dismayed and left my side in tears."

Since that time many years have been spent in research, and hundreds of experimental examinations—conducted by such men as William Moulton Marston, Vittorio Benussi, Harold Burtt, John Larson, and Leonarde Keeler—have definitely established the fact that con-

*Figure 1:* The author and Keeler Polygraph

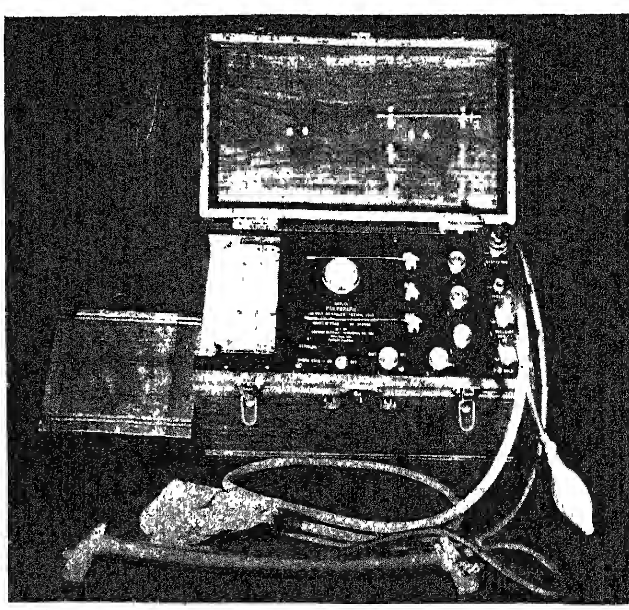


*Figure 2:* The Keeler Polygraph. In the foreground are the pneumograph (large tube; see Figure 1) and blood-pressure cuff (the irregular white object)

# OF LIES

## Where Stands the "Lie Detector Machine" Today? . . . Sensational Claims and Sound Science . . . Replaces Third Degree . . . The Superstitious Porter Shied Off

scious lying causes certain emotional disturbances which can be recorded.

In 1913 Marston began research in the Psychological Laboratory at Harvard University, regarding the detection of deception. After innumerable experimental tests he became assured that it was impossible for a normal person to lie without effort. Expended effort, he found, either mental, nervous or otherwise, caused an increase in the strength of the heart beat and necessarily an increase in the systolic blood pressure (the pressure in the arteries at the time the heart contracts and forces the blood through the body).

*Figure 3:* Attaching the blood-pressure cuff

The following year at Graz, Austria, Bennussi devised a test based on the principle that the respiration rate was affected by the effort of conscious lying, and that these changes could be accurately gaged. Some three years later, in the same laboratory where Marston had worked, Burtt further developed Bennussi's method.

Then, in 1921, Dr. Larson, working with the famed criminologist August Vollmer at Berkeley, California, combined an Erlanger Sphygmomanometer (apparatus used by physicians to determine blood pressure) with a pneumograph (a one-foot length of ¾ inch diameter spring encased by light rubber tubing for recording respiration) and conducted a series of tests on suspects and prison convicts. Although Dr. Larson did not treat his material statistically, he reported a high degree of accuracy in his findings.

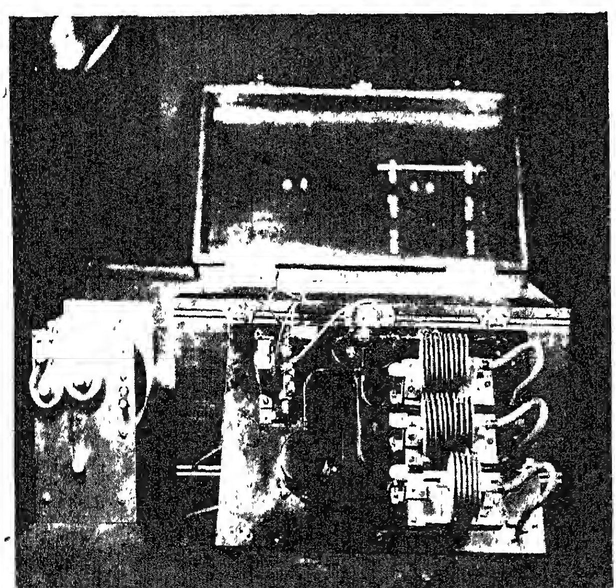


*Figure 4: Left:* The kymograph mechanism unrolling paper. *Right:* Inner mechanism of the Polygraph, showing the three metal bellows mentioned in the text

In 1925 a young student at Stanford University, Leonarde Keeler, began the assembly of an instrument which he called the "Keeler Polygraph." During his years in the psychology department at Stanford and later (1930) when he became Assistant Professor of Law, Scientific Crime Detection Laboratory, Northwestern University, Professor Keeler, now a well known criminologist, perfected his instrument for recording continuously the blood-pressure, respiration, and psycho-galvanic reflexes of a subject under examination.

Having studied and experimented with the emotional factors accompanying deception, Professor Keeler arranged his instrument to record the various voluntary and involuntary bodily changes in a lying subject simultaneously. Thus the name "Polygraph" ("many-graph") came into being. Several graphs made simultaneously with well selected relevant and irrelevant questions as the stimulus, cause certain reactions which can be correlated and truthful answers and falsehoods separated.

ALTHOUGH Professor Keeler does not claim that his instrument (Figure 1) is a "lie detector," it is commonly known by that name. Because of sensational claims made by some writers of the news and others whose facts were not well founded, a lay public has been led to believe that a light flashes or a bell rings each time an examined subject strays from the truth. The facts regarding Keeler's Polygraph are quite the reverse. The instrument is used much as the physician uses his stethoscope, his clinical thermometer, and his blood count apparatus—as a means of diagnosis. Certain symptoms, combined with a case history and other indicating factors, assure the physician that his patient has an infected appendix, arthritis, or other disease. Certain delusions and other accompanying factors assure the psychiatrist that his patient is psychopathic, and in a like manner certain reactions in Polygraph tests, combined with other accompanying factors, assure the Polygraph expert that his subject is not telling the truth. The instrument itself is simply the tool with which the deception is detected.

The Keeler Polygraph (Figure 2) consists of three units housed in an 18 by 9 by 7 inch case. One unit is for continuously recording the changes in blood-pressure and pulse; another gives a duplicate blood-pressure record, and a third is for recording the changes in respiration. Ordinarily the duplicate

blood-pressure unit need not be used.

In order to record the bodily reactions a pneumograph (rubber tube containing a metal coil spring) is adjusted about the chest and a blood-pressure cuff is snugly wrapped about the upper right arm (Figures 1, 3). Both the pneumograph and blood-pressure cuff are attached to the instrument by means of four foot lengths of rubber tubing. The rubber tubes connect with metal tambour stacks or bellows (Figure 4) located immediately beneath the instrument panel inside the case. The tambour stacks in turn are attached to pivots which protrude through the panel and to which are attached long arms. At the end of each arm is a small ink cup which tapers at the bottom and forms itself into a pen. The cups are kept filled with ink, and feed the pens which ride upon a slowly moving graph paper. The graph paper is unreeled by a kymograph mechanism (Figure 4) at the rate of six inches per minute.

When all adjustments have been made, the blood-pressure cuff is inflated (note bulb, Figure 2) to a point midway between diastolic (minimum) and systolic (maximum) blood pressure. The midway point is called "mean" pressure and can be determined by the position of a dicrotic notch which appears in the blood-pressure-pulse record. As the heart forces the blood through the artery beneath the inflated blood-pressure cuff, the volume of compressed air inside the cuff is changed with each beat and transfers that change to the pen arm by way of the metal tambour stack and pivot. The pen arm moves with an up-and-down motion, causing the pen to record on the slowly moving graph paper each heart beat and change in blood pressure.

SINCE the second element of the apparatus, the pneumograph, is adjusted snugly about the chest, inhaled air expands the chest and elongates the tube. When the air is expelled from the lungs the tube contracts to its original length. These elongations and contractions of the pneumograph change the amount of air within the tube, causing these changes to be transferred to the pen arm by way of another tambour stack. The flow of ink from the pen records each breath taken, as well as any changes in the respiration, at the same time the other unit is recording the blood-pressure and pulse.

The graph paper is divided by three principal horizontal lines, each from left to right, as shown in Figure 5, and into many spaces by lines in the other direction. The upper horizontal line is the region for recording the respiration. The center (not always used) is for recording the duplicate blood pressure, and the bottom for recording the blood-pressure pulse wave. The vertical lines represent a period of time—one second each for the lighter lines and five seconds each for the heavy lines. Since the kymograph mechanism unreels the graph paper at the rate of six inches per minute, one of the lighter lines passes beneath the pens each second the instrument is in operation. Thus the operator is given an exact account of the time required for his stimulus question to take effect, the length of time required for a return to normal, and an easy check on the number of heart beats per minute.

A subject taking the Polygraph test is seated facing away from the instrument so that his interest is concentrated on the questions being propounded and not upon the fluctuating pens recording his reactions. About every 30 seconds he is asked a question and is required to answer with a simple "yes" or "no." The operator first establishes a normal by asking irrelevant questions: "Have you had breakfast this morning?" "Is this the month of February?" and so on.

After the normal has been established, the questions are arranged so that they hint at intimate details of the crime under investigation. Necessarily, if the subject is not acquainted with those details, and if the test is properly controlled, his reaction to the hints will be no greater than to irrelevant questions. If his record indicates that he had knowledge of the details—if he reacts to hints—questions concerning the actual crime may then be propounded. Significance is attached only to the deviations from the established normal at points where the stimulus questions are relevant to the crime under investigation.

The progressive police of the nation were quick to recognize the value of Keeler's Polygraph. The need for such a device was acute. The old so-called "third degree" methods of obtaining the truth had been proved inefficient so far as actual results were concerned and were frowned upon not only by an indignant public but by the police themselves. A quick and easy means of getting true facts simplified the work of the police and added another scientific weapon with which they could combat crime. Fortunately, however, Professor Keeler limited the distribution of his instrument to the medical profession, certain educational institutions, and recognized law enforcement agencies who could produce men capable of becoming skilled operators. An instrument of this nature in the hands of an unskilled or unscrupulous person would be a very dangerous thing. The operators therefore are required to take certain training, to become proficient, and to demonstrate their ability, before an instrument can be purchased by the group he represents.

EARLY in 1933 the Wichita Police Department, having met the requirements laid down by Professor Keeler, purchased a Polygraph. In the beginning the new "lie detector" was a target for many derisive jests, but the ensuing three years changed the minds of the skeptical, and a full-time operator is now kept busy examining that never ending line of subjects whose stories and alibis have sounded false to investigating officers.

During the year 1936, a total of 1262 suspected persons were sent to the Polygraph Room where, as operator, I conducted truth tests. Of the total, 339 were found to be lying, and of that number 151 made full confessions of their guilt. On the other hand, 919 were found to be telling the truth and were immediately

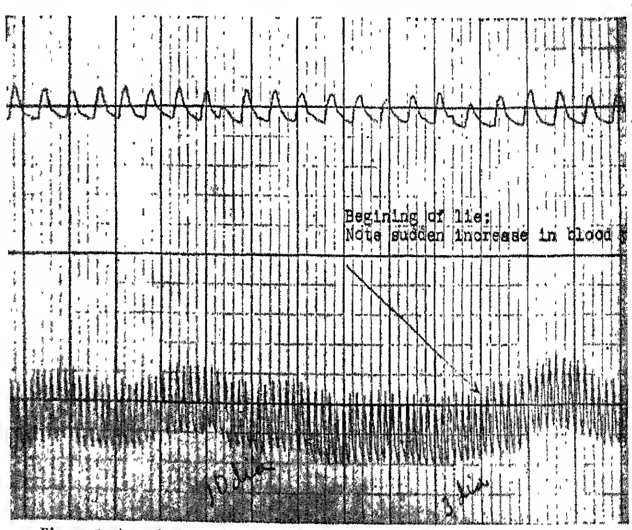



*Figure 5:* **A typical graph. This graph depicts the sudden rise in blood pressure at the point of attempted deception. The subject was handed ten well-shuffled playing cards, with instructions to choose a card and then lie about his choice. Respiration at top, blood pressure below. Notice where he said "No" to the three of diamonds. He later admitted that the three of diamonds had been his choice. Such tests are often used to obtain controls—that is, find the normal**

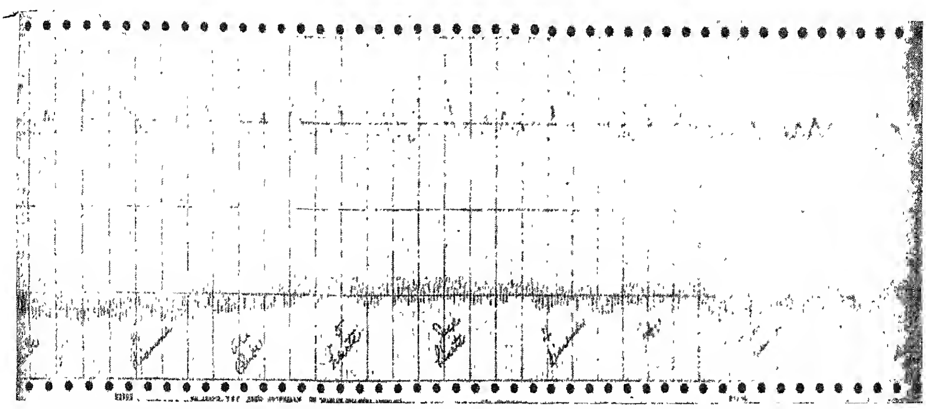


*Figure 6:* **Another graph, this one indicating very clearly the relief following deception. The subject had selected a playing card and lied about his choice while the Polygraph recorded his respiration and blood pressure. Note abnormal breathing (top) up to point near center where he answered "No" to the Jack of Hearts. From then on to the end he showed almost normal breathing. (Breathing is at top, heart at bottom.) The Jack of Hearts, however, was the chosen card**

released from custody. The "lie detector" not only detects the guilty, but serves to establish the innocence of those falsely accused.

To my office come people from all walks of life: honest people, thieves, suspected murderers, shoplifters, fleeing criminals, vagrants, and a host of others. All are suspected of one crime or another and it is my duty to weed out the guilty and secure immediate release for the innocent. Let's look back on some actual cases and see what happened.

Late in December, 1935, the vice-president of a bank came to Police Headquarters for assistance. His story was an odd one, but nevertheless true. He advised that a certain transfer of money had been made to his bank the day before and that one sack containing a sizable sum had disappeared. The teller who had received the sack remembered that during the rush hour the sack had fallen off the counter to the floor. Busily engaged at the time, the teller decided to leave the sack where it had fallen until after the rush. The teller, being human, did a very human thing—forgot all about the sack until late that night. He rushed back to the bank and to his cage, but the money was gone. During the previous afternoon numerous bank employees had been in and out of the teller's cage and, since the sack was out of reach of the public, the vice-president concluded that some member of the bank's personnel had stolen the money, sack and all.

The bank's personnel consisted of some 50 people. The process of elimination finally narrowed the field to seven who had had an opportunity to commit the theft—those who had frequented the teller's cage during the afternoon. But who was to be accused? The seven were trusted employees. How was the guilty person to be singled out? The police suggested a Polygraph examination for the entire group.

This suggestion met with the approval of both the vice-president and the suspected men and the Polygraph was set up in a room at the bank and the examinations begun. The afternoon slipped into evening but the tests continued. One after another the suspects ran clear records. Late that evening the negro porter was brought in for his turn on the instrument. He had cleaned the cage shortly after the bank had closed the previous evening, and was among the seven to be examined. The negro was superstitiously inclined and obviously badly frightened. The whites of his large round eyes were an extreme contrast to his face, and be shied at the box-like instrument sitting on the table. After much explanation and assurance that the instrument would not injure him, the porter was finally induced to sit in the chair and allow the pneumograph to be adjusted about his chest and the blood-pressure cuff attached to his arm. Questions concerning the stolen money bag brought violent increases in blood-pressure and a suppression of respiration—an unmistakable indication of deception.

We soon learned that the man's fright was not all superstition. Much like the Hindu who emerged from the room with clean hands, his fear of the consequences of exposure led him to expose himself. In trying to suppress his emotions he had only succeeded in increasing them. After the examination was completed he was accused outright and the records were explained to him. Later that evening he confessed the theft and led detectives to an abandoned house where he dug several hundred dollars of the stolen money out of the unused chimney.

Another case: Near the Colorado border, the general store in a small town had been entered late one night. The burglar had stolen all the cash from its hiding place and then set fire to the building to cover his crime. Nearby farmers, seeing the blaze, rushed to the scene and extinguished it, but the culprit had fled. The sheriff conducted an immediate investigation and some days later arrested a young man who had previously been employed in the store as a clerk. The young man vigorously denied any knowledge of the crime and withstood a ten day grilling by officials, and all but convinced them that he was telling the truth. To be sure of their findings, however, the officers asked that he take a Polygraph examination. He consented and was brought to Wichita. One hour after he arrived at headquarters the results of his tests were laid before him and explained in detail. The Polygraph records indicated that the young man was lying; that he was the burglar; and that he had attempted to burn the building to cover his crime. He finally admitted that the instrument had recorded the truth and signed a confession giving full particulars of the crime. The Polygraph had accomplished in that hour what a ten-day grilling had failed to accomplish before.

An outstanding case was the investigation of a one-way-ride gang murder. A dead man was found at the wheel of a truck in Kansas and was identified as a rum-runner. He had been shot. The Highway Patrolmen took into custody a man who "might know" who killed the truck driver but he refused to talk, except to insist that he knew nothing concerning the killing. To prove his statements he agreed to a "lie detector" examination. Given the "name" test—a group of names of men who "might" have committed the crime—he gave little or no apparent response, except to one name at which his blood pressure and respiration became abnormal. He confessed.

Hundreds of instances like these may be found on file wherever the Keeler Polygraph is in operation. The final reports on some of the cases read like leaves torn from some strange fiction story—but they're true.

# WRITTEN WITH THE

## Dura . . . Archeology's Most Hectic Day's Work . . . Found the Contracts, Mortgages, Accounts, Receipts, Letters, and Wills of the Ancient Citizens

IT was on March 30, 1920, during the Iraq war. Captain Murphy had camped his company of East Indian troops on the cliff above the mud village of Salihiyeh, commanding the Euphrates crossing, where the grim walls of an ancient fort offered a little protection against Arab sharp-shooters. Strolling among the ruins, he stepped into a tower room from which some trick of desert winds had emptied centuries of sand. The walls were alive with astonishing bright priests and worshippers—frescoes.

He hastened to notify his superiors, who notified Miss Gertrude Bell, who notified the late James Harvey Breasted, then surveying Babylonia for the new program of the Oriental Institute, Chicago. Breasted rushed to Salihiyeh, arriving on May 3 to find Murphy ordered to evacuate this advanced position. In one working day Breasted made color notes of the frescoes while his assistants feverishly photographed: it was archeology's biggest single day's work, and then they rushed on upstream to safety.

The book that resulted, Breasted's *Oriental Forerunners of Byzantine Painting*, created a polite archeological furore. The frescoes contained the name of the town, Dura, solving one more problem in Mesopotamian topography, but raising a thousand new fields of speculation in Syrian and Parthian art.

IN the meantime the Académie des Inscriptions et Belles-lettres had sent Franz Cumont to dig there and soon the historians had something more appetizing than any fresco to sink their teeth into, for Cumont was turning up the stuff of which the history textbooks of 1960 will be written: vast temple complexes, a long series of Greek inscriptions—yes, Greek—and parchments. Dura began to be a historical landmark.

About 300 B.C. Seleucus I's leading general, Nikanor, built a guard post where the caravan trail along the Euphrates forks for Palmyra, and called it Europos, after Seleucus' birthplace in far-off Macedonia; the Bedawi promptly named it *dûr*, 'wall'.

At first there was no proper settlement—just a barracks for the Greeks on guard. But the situation offered tempting commercial possibilities, and a few Syrian traders settled there. Perhaps they brought their daughters—at any rate, the Greeks raised families and founded a little half-breed dynasty. The fort grew into a model walled city, and trade prospered in its shelter.

With the collapse of the Seleucids about 130 B.C., Dura became the ranking fort of Parthia's western frontier. Far different from what the Roman armies they repeatedly whipped would have us believe, the Parthians now appear as enlightened and considerate rulers of the vast provincial empire they flung together. Certainly the change made little impression on the inhabitants of Dura: no Parthian carpet-bagger could have been induced to settle there at any price, and her municipal laws and organization were not disturbed.

The inscriptions dug up by Cumont, and later by ourselves, reveal some aspects of the local government. The Senate, consisting of the heads of leading clans and prominent traders, met in a small *bouleuterion* in the temple of Artemis (Figure 1). Presumably all matters of municipal justice, discipline, and comfort came under their control.

In each of three temples was a hall flanked by rows of steps, which became reserved seats for the ceremonies when Dura's aristocratic ladies carved on them the date and their names, their fathers' and grandfathers', and their husbands', sometimes also their husbands' fathers' names. From these hundred genealogies-in-brief we can reconstruct the family trees of half a dozen of Dura's most prominent clans, one in particular through two centuries of the city's history; to that family, descended from a Greek soldier and a native girl, belonged every *strategus* ("mayor" or "governor"—the title originally meant "general") of Dura during the Parthian period.

That dignity was therefore hereditary like that of an Arab sheikh today; when one even calls himself *genearches*, Greek for "sheikh," it is hard to distinguish between their functions. Like the Ptolemies in Egypt they married within the family to keep the race pure, a custom they did not learn from the European side of the house.

THE parchments alone guaranteed Dura archeological immortality. On parchment in Syria as on papyrus ("paper") in Egypt were kept the archives of antiquity, contracts and mortgages, accounts and receipts, letters and wills. At Dura alone of Syrian cities, however, were they buried so rapidly they had no time to rot; until the discoveries there, Egypt had a practical monopoly of such

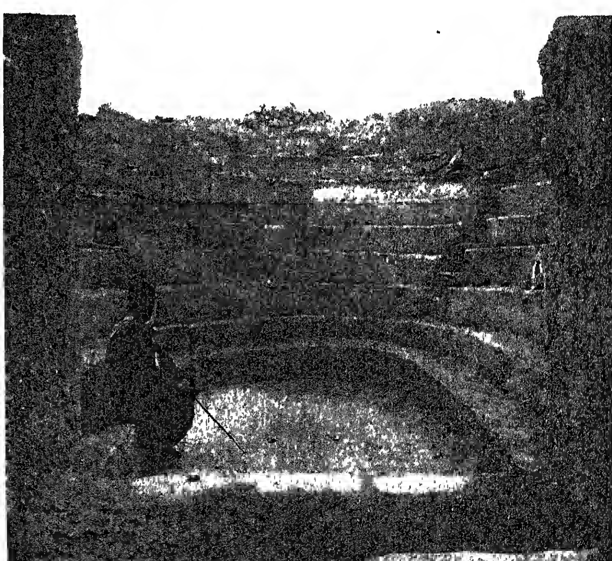
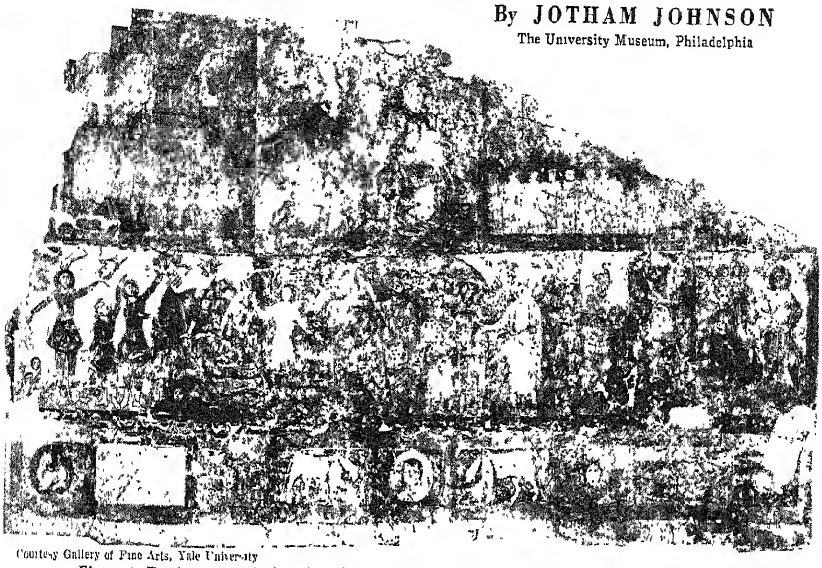


Photo Serge Dairaines, courtesy Gallery of Fine Arts, Yale University

*Figure 1:* A Beduin foreman poses in the senate-chamber of ancient Dura

# ARCHEOLOGIST'S SPADE

By JOTHAM JOHNSON
The University Museum, Philadelphia



Courtesy Gallery of Fine Arts, Yale University
*Figure 2:* Earth once packed against the walls covered up and thus saved the synagogue frescoes

information on private commerce and society, and it was very much of a question how much Egypt could teach us by inference about Syria and other Hellenistic kingdoms.

Therefore when Cumont turned up two bills of sale, fragments of the official ledger in which were abstracted all registered deeds and contracts, a loan, a summary of the law of inheritance in intestacy, and a painted shield showing the travels of its owner, all in Greek, plus two lists of soldiers in Latin and a letter in Aramaic, it was *news.*

We now know, for example, that the code used at Dura (and the rest of Syria?) was independent of the Egyptian, resting rather on an older Babylonian code. In a city held by Parthia for three centuries we are surprised to find no trace of Parthian meddling with the local laws; but this only indicates that they saw no need to interfere where the local people were competent to take care of themselves.

At this time Dura's culture was most heavily in debt to Palmyra, the luxurious caravan capital half way to the Mediterranean coast. Agents and camel boys brought with them their own religious customs, and that tower, whose frescoes astonished Captain Murphy, proved in fact to be a temple dedicated to Palmyrene gods by a prominent Dura family.

Where such documents had been found it was not safe to predict what would not turn up. When Cumont's two fat volumes came out it was easy for Professor Rostovtzeff of Yale University to persuade his administration to take up where Cumont had left off, and only this spring was Yale's tenth and last consecutive season at Dura-Europos concluded.

The first director of the excavations under Yale was French—M. Maurice Pillet who had dug at Susa in Elam and Karnak in Egypt. As assistants in 1928-9 he had Dr. Clark Hopkins and myself. We too found parchments. In one, Phraates the Eunuch lends Barlaas 400 drachmas in good silver, Barlaas contracting to work for Phraates in lieu of interest. And inscriptions: an altar (Figure 3) was set up to Almighty Zeus by the cautious populace after an earthquake which occurred about 10 A.M. on October 27, 160 A.D. And, scratched on the plaster walls, graffiti—scraps and jottings too personal and ephemeral to waste parchment on, potentially as interesting as the parchments themselves.

ONE graffito I noticed on the wall of a private house which had been dug clandestinely by soldiers stationed there to prevent clandestine digging. It proved to be a horoscope, showing graphically the positions of the seven planets (sun and moon included) among the constellations of the zodiac. From this Dr. Dirk Brouwer of Yale's astronomy department was able to work out its Julian date, July 3-5 or 10-12, 176 A.D. With this to go on I could decipher a few more letters scratched above the horoscope; they gave the date by the Seleucid calendar, Panemos 9 of the year 488, equivalent to July 4, 176 A.D., a shiny feather for Dr. Brouwer's cap. This taught us that the lunar calendar survived late at Dura; second that the Neo-Babylonian calendar, a 19-year cycle of intercalary lunar years in effect since 383 B.C., had been taken over by the Parthians and was still swinging on its way unchanged; and third that the populace were believers in astrology.

Dura's first papyrus also turned up in my lucky sector, in the bottom of a tower of the city's main gate, but we did not then know that Clark Hopkins, succeeding Pillet as director, was to sink his shovels into the record-office of the Roman prefect and find still preserved there sheaves of army records on papyrus, one of the great archeological finds of this or any age.

Dura had been occupied by Trajan about 115 A.D., but Hadrian soon ceded it back to Parthia. In 165 A.D. Lucius Verus annexed it for good. True to Roman practice, Roman law was imposed but local religious customs were not interfered with. In the sprawling temples that characterize Dura's architecture continued to flourish the pagan worship of strange Oriental gods and goddesses, Nanaia, Hadad and Atargatis, Azzanathkona, Mithras, Aphlad, Bel, Yarhibol, and Aglibol. Altars and small reliefs dedicated in bad Greek to Zeus, Artemis, and Apollo, Nemesis or Herakles seem even more out of place when accompanied by Aramaic translations in

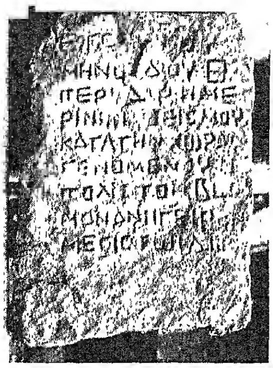


*Figure 3:* **"An earthquake occurring throughout the land, in the year 472, on the ninth day of the month Dios, about the fourth hour of the day, the city set up this altar to Zeus Megistos", this reads**

the picturesque Palmyrene alphabet. Tyche, however (Gad of the Semites, Fortuna of the Romans), was perfectly at home wherever Rome's oriental army reached.

To Rome's policy of tolerance we owe the addition of Christian and Jewish congregations to Dura's confused religious panorama. Less beautiful as art than the frescoes of the Temple of the Palmyrene Gods, less important for science, but sentimentally far more significant to the rank and file of us today, Dura's most memorable archeological moment was Clark Hopkins' discovery in 1931 of the oldest frescoed Christian chapel yet known. Its scenes, painted soon after 200 A.D., and published in 1935, are already famous: Adam and Eve, the Good Shepherd, the Paralytic Who Took up his Bed and Walked, Christ Walking on the Water, the Marys Approaching the Tomb, David and Goliath, and the Samaritan Woman.

BETTER art, and of wide interest outside of Germany, are the only Jewish synagogue frescoes (Figure 2) so far unearthed, discovered by Hopkins in 1932 and now finally published. They were painted between a rebuilding of the synagogue in 245 A.D. and the siege of Dura in 256 A.D., and if they clash with the basic archeological axiom that the Jews had no church art, our only refuge is the assumption that at that date Jewish religious sentiment had not crystallized into aversion to pictorial art. And indeed the editors find support for this in the existence of medieval illuminated Jewish manuscripts and in modern discoveries of Jewish catacomb decoration in Rome and of Old Testament scenes in synagogue mosaics from Palestine. If other synagogues of the time had comparable frescoes, we are no longer at a loss to explain that Christian art of which Dura herself provides the most conspicuous primitive example.

In other ways, too, Dura was transformed under Roman guidance. Polyglot troops from all over the map added to the color and noise of Dura's riotous streets. Right in the passageway of the busy Palmyra Gate they installed their shrine to Tyche. They took over a large area in the north end of town for administrative offices and in 216 A.D. built a tiny amphitheater, with space only for a thousand spectators. They insisted on Roman standards of hygiene and comfort, and built four Roman baths. The water was lugged painfully up on donkeyback from the river valley below; heaven knows where the fuel came from in that treeless land.

I don't know that Dura has any great message. It is not a 20-stratum "laboratory mound" of the Painted Pottery Peoples, stretching 7000 years back into prehistory, like Tepe Gawra and Tepe Hissar [described in Scientific American, respectively, October 1935 and May 1937.—*Ed.*]. It is rather a melting-pot of Greek, Babylonian, Syrian, Persian, Palmyrene, desert Arab, and Roman cultures, just as to at least one of its diggers it is a confusion of single memories, not all archeological: the six-foot skeleton in one of the towers, the rope by which he was hanged still around his neck; the tomb of a medieval Arab chief (Figure 4) which we dared not touch for fear of a riot among our workmen; deciphering inscriptions at the Palmyra Gate at night, when a flashlight cast shadows sharp enough to make them legible; the viper that struck at me (he missed); the endless wrangling over the date of the walls, not even now resolved, and our perpetual wonder that the Parthians left so few traces of three centuries' occupation; my first sandstorm; the workmen crossing the river on inflated skins at dawn, just as on the Assyrian reliefs.

But Dura might also crash the pages of world history for the story of her siege by the Sasanians in 256 A.D. The city was defended on the east by the Euphrates cliff, on north and south by wall-crowned ravines. Only on the west, facing the open desert, was Dura's wall vulnerable.

AS Dr. Hopkins has reconstructed the siege, the Sasanians tunneled under one of these west towers, shoring it up as they went, planning when all was ready to burn the timbers, bring the tower crumbling down and rush in through the breach. The defenders feverishly countermined.

Where they met, the Sasanians had the advantage of a sharp fight but, not daring to pursue, they fired the defenders' mine, walled it up and withdrew, leaving the wounded to die screaming in the blazing gallery. Then they calmly completed their own mine and fired it. The supports gave way and the tower settled, but did not collapse and still was adequate to repel the enemy.

While the worried householders hid their jewels and money for Yale to find, the Sasanians drew off to reconsider. Smarting from the defenders' yells of derision, they toiled under a shower of lances, arrows, and sling-stones to build a ramp against the wall. Simultaneously a new mine demolished the corner tower and a wide tunnel nearby let loose a flood of Persians within the city.

By these means the walls were rushed and Dura was sacked. No one returned to recover his hidden treasures, no one but a lone hermit ventured back to share the ruin with wolves and jackals, and desert storms soon mercifully covered it with sand.

And of all this no ancient writer says a word. The whole story was written with the archeologist's spade.

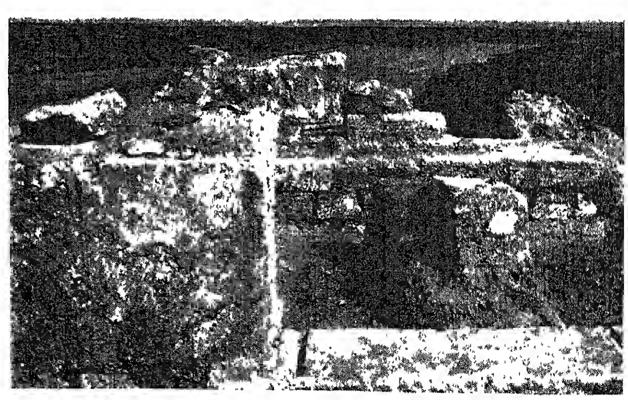


*Figure 4:* **In the vestibule of the Parthian palace, looking over the interminable desert, we discovered the tomb of an Arab sheikh and left it inviolate**

# HOMALODOTHERIUM FOR SHORT

By ALBERT G. INGALLS

THE awkward appearing extinct mammal shown below once lived in Patagonia, in the Miocene Epoch of the Tertiary Period or "Age of Mammals," an epoch which lasted from about 19,000,000 years ago until 7,000,000 years ago. The word Homalodotherium, with accents on the "ma" and "the," is the briefer of two forms of the same animal's name, the other being one syllable worse—Homalodontotherium; but since the main accent was found to fall on the "dont," the sensible advice it gave has been applied to this form of the word and the longer name is seldom used.

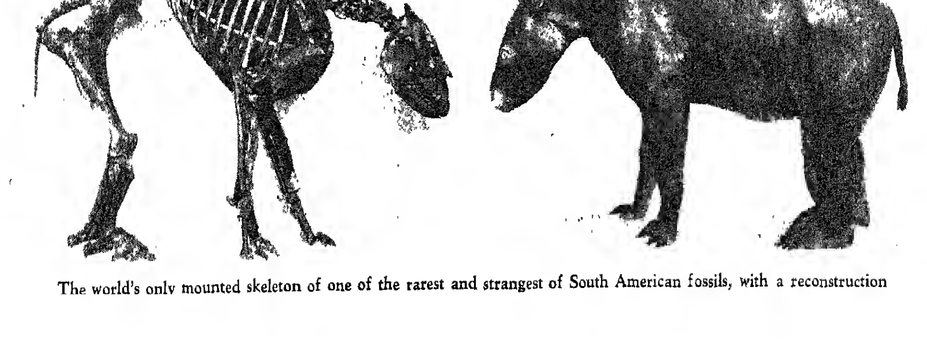
The skeleton (left) and reconstruction (right) are on exhibition in the Field Museum of Natural History in Chicago. The skeleton was discovered by Elmer Riggs, Associate Curator of Paleontology, in a block of sandstone which had fallen from a cliff on the eastern shore of Patagonia and was rapidly being worn away by waves on the beach. This is the only mounted skeleton in the world. The reconstruction was made by Phil C. Orr. To fill in the soft or body parts, in making reconstructions, paleontologists have far more than guesswork to go by. Bones show where muscles were attached, and the proportions and relations of the bones tell many things derivable from common principles of mechanics. Study of living animals of all kinds provides certain laws and verifies them, and in many cases these have been checked by actual finds. A paleontologist cannot reconstruct a whole animal from a toe bone, but one need not study paleontology long in order to note the surprising amount of safe deduction that can be made from a little evidence if one is aware of the principles. Sherlock Holmes did no better with tobacco ashes, pencil parings. and other trifles.

What an odd "critter" Homalodotherium was! As big as an ox, but with stupid look and tiny ears on a too small appearing head, massive hind legs and long flat feet, heavily muscled forelegs and rather sloping, clumsy body like that of a middle aged man who had lived too well. His teeth were excellently adapted to cutting and grinding vegetation and not at all designed for meat eating, yet he was equipped with powerful claws. This combination tells its own story: an animal that lived largely on grass and tubers, possibly roots, and carried with him his own powerful tools for digging them up.

THIS ungainly beast is chiefly of interest, however, because he is a relic of a "lost world"—mid-Tertiary South America. Most readers are familiar with the fact that the animals of Australia, to take another example, are peculiar if not bizarre. This is because Australia has long been an island, and evolution has gone its own way there, diverging from that of the continental land mass. Similarly, Africa contains an odd mammalian fauna and for the same reason: while this was evolving it was an island continent. For about 40,000,000 years South America was similarly shut off from the main current of mammalian evolution because the land that now forms the Isthmus of Panama gradually sank beneath the ocean late in the Eocene Epoch of the Tertiary Period, and stayed sunken for about 40,000,000 years. (Its unkind emergence cost your Uncle Sam $525,812,661.) During those millions of years evolution in the island continent of South America took its divergent course, hence the bizarre mammals found in fossil form there: not alone the one shown below but tree sloths and immense ground sloths, ant-eaters and their cousins the armadillos, as well as the heavily armored glyptodonts, as big as a hogshead, with large spiked bony clubs on their tails.

Now the story cuts back like a motion picture or novel, to see what was going on in North America while these bizarre beasts were evolving in South America. There we find the evolution of the mastodons, the three-toed horse, the camel (strictly "made in the U.S.A." and exported, millions of years ago, to the Old World; later it became extinct here where it was made, and today camels are imported for circuses; the horse was a parallel case), titanotheres, rhinoceroses in Nebraska and elsewhere, and literally thousands of other mammals—the whole forming an assemblage of mammals much more varied and numerous than in our times.

When the land again arose between the two continents and afforded a bridge, reciprocity was adopted and about 5,000,000 years ago the fauna of either continent spread to the other. That accounts for the presence in North America of some of the odd South American improvisations—for example, the common small armadillo. A large part of all these mammals became extinct. We still live, however, in the Age of Mammals, but we, ourselves, are rank outsiders in both of the Americas. During most of the evolution described above our own ancestors were Old World apes. Some say, of course, that they were not apes, because man and the apes evolved from a common stem. However, should you meet that "common stem" you probably would find but one term that really fitted him.



The world's only mounted skeleton of one of the rarest and strangest of South American fossils, with a reconstruction

# FENCES, BRIDGES, ZIPPERS

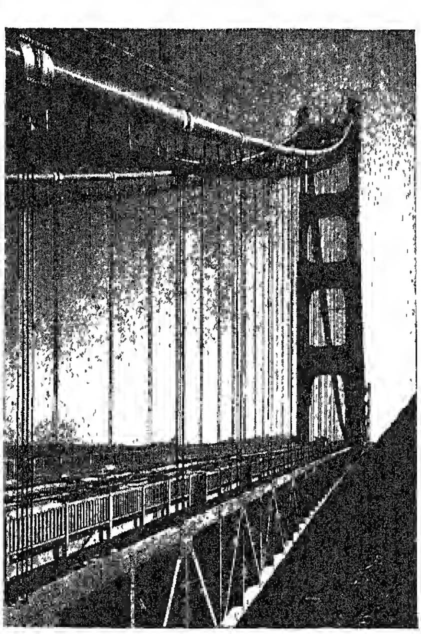
## Wire . . . In Industry, Everyday Life . . . For Man-Sized Jobs, For Tinsel . . . Important New Electro-Galvanizing Process . . . "Tailor-Made" Wires

By PHILIP H. SMITH

OUR civilization is built upon wire, wire makers claim. Rather, wire holds our civilization together, because to dispense with it would throw us back to the horse-and-buggy days if not further and that would virtually mean collapse.

You cannot live and still escape using wire in one or more of its various forms. You encounter it first as a safety-pin and from then on it serves in countless guises until the final coffin nail. If wire's importance is unappreciated it is because its products often depart so radically in appearance from the basic form. Tinsel, for instance, which cascades from Christmas trees, doesn't resemble wire, but it is a wire product. So is the "zipper" fastener.

The manufacture of wire and wire products is an industry which comes close to the half billion dollar class. When things were not humming in 1935, over 2,000,000 tons of plain iron and steel wire were produced. Copper wire followed with a tonnage of more than 200,000; brass and bronze wire with 37,000 tons; while other non-ferrous wires aggregated some 10,000 tons. Among the many products of wire, such small items as nails, brads, and spikes accounted for a tonnage of over 478,000, while coat hangers absorbed 7600 tons. Just to keep flies out of the house required that mills produce 23,000 tons of screening. And these figures are for a year of little activity!



Golden Gate Bridge, where 79,792 miles of wire (in two single cables) support a span 4200 feet long

THE manner in which small wire necessities roll forth by the ton to satisfy the consuming public is really astonishing, but there are more concentrated uses which consume wire products in a way to defy imagination. A suspension bridge is one of them. When a bridge calls for a single span 4200 feet long, the amount of wire required for suspension is tremendous, and that's what we find in the newest of bridges: the Golden Gate Bridge in California. Here are just a few of the wire items required; a complete list would swamp this article:

The two main cables contain 79,792 miles of wire, weighing 21,392 tons. There are nearly 40 miles of wire-rope suspenders, five miles of wire hand-rail strand, two miles of strand to support electric cable, and two miles of cable for outline lighting. All this material stays in the bridge, but to erect the bridge takes about 45 miles of wire rope, 50 miles of wire strand, and 237 miles of electric light, power, and signal wire.

These enormous tonnages and mileages are difficult to grasp and they serve only to indicate that anything connected with this industry is gargantuan. Our particular concern, however, is with the question of what the industry is doing today in the forward march, rather than to prove that it is essential, gigantic, and still growing.

Despite the highly specialized state of the wire industry, there are still vestiges of the rule-of-thumb method of operation. In recent years, rapid progress has been made to establish more scientific control and to this end metallurgists and men with technical training have made contributions. Outstanding in the forward march has been an increase in drawing speeds, the attainment of closer tolerances, and greater uniformity of product. Better machines, vastly improved dies, and higher technical skill have led straight to superiority of product, cheaper because produced more rapidly and, in certain instances, more suitable because made of metals which could not previously be drawn commercially. The import of these gains will become evident if the art of wire drawing is refreshed in the memory so that comparison can be made.

Wire starts in the form of a rod about ¼ of an inch in diameter. This rod is pulled through a die to reduce its size, and, after a series of such passes, each making a further reduction, the resulting wire is wound up on a reel. When copper is drawn through the die it is reduced by about 26 percent of its cross-sectional area each time it passes through. In the case of steel, the reduction runs from 20 to 30 percent depending on what type of rod is used. The dies are made of very hard steel or diamonds, the former for large size wire and the latter for fine sizes.

IN the light of present-day knowledge, there were many things unsatisfactory in the operations of not so many years ago. The steel dies wore off-size so that uniformity in size of product could not be obtained in long lengths. To get a uniform product, the machine had to be stopped, a new die installed, and the process begun again. Also much wire had to be rejected. After the first pass, the wire had to be carried to another machine and then others until the proper reduction had been obtained. This made for much handling and loss of time.

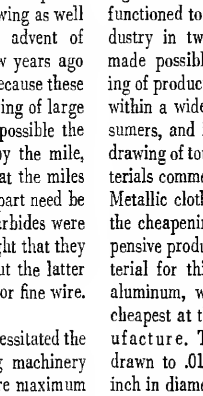
Today's high-speed machine performs multiple operations. The wire passes from one die to the next in a series so that complete size reduction takes place on one machine. As fast as one bundle of rods has been reduced, another bun-

dle is welded to the end to give an almost continuous feed. Speed of drawing has been doubled, tripled, and increased even more, depending on the metal being drawn.

If any single thing has made possible this increase in speed, continuous operation, and uniformity in product, it is the improvement in dies. The die is really the heart of the drawing machine. Any failure of the die means damaged or off-size wire and stoppage of the machine. Speed presupposes that the die will "take it" and remain true to size so that the product will meet with specifications at the end of the drawing as well as at the beginning. The advent of cemented carbide dies a few years ago was the great step forward because these dies permit high-speed drawing of large diameter wire; they made possible the drawing of wire literally by the mile, with the sure knowledge that the miles will be all the same and no part need be rejected. When cemented carbides were first introduced it was thought that they would replace diamonds, but the latter still hold their own in dies for fine wire.

CEMENTED carbides necessitated the redesigning of drawing machinery to eliminate vibration, before maximum advantages could be enjoyed. Wire must pass through the drawing machinery at proper tension and the operation must be synchronized with the greatest care. It is obvious that speeds step up with each phase of the reduction—rod speed and finished wire speed are far apart. Not only must these various speeds be controlled but provision must be made for any slippage along the line. Uniformity of elongation is a prerequisite of good wire.

In addition to higher speeds of production and uniformity of product, there is another advantage in modern equipment. It is possible for one man to attend to several machines so that his productivity has been multiplied as many as four times. Then, too, multiple operations save floor space and the amount of handling required.

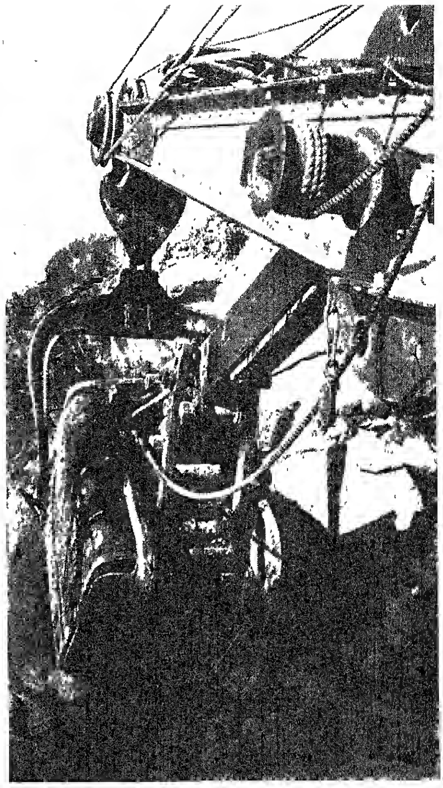

Wire Drawer and Equipment Germany A D 1421

There is, of course, a limit to the length of time wire can be worked in the drawing process, because drawing is really a cold-working operation which hardens as well as increases the tensile strength of metal. Annealing must be resorted to at intervals, depending upon the physical and chemical properties of the metal being drawn. Both pressure and heat are encountered when the metal passes through the die to be deformed and elongated; therefore a lubricant must be employed. Ordinary soap is the lubricant base and the wire must be carefully prepared before the drawing begins. Steel rods are rusted and then dipped in lime. Copper is dipped in sheep's tallow. Stainless steel, which cannot be corroded so that the lubricant will cling, is coated with a lead alloy to provide a suitable lead lubricating sheath.

The improvement in drawing machinery and dies has functioned to advance the industry in two ways. It has made possible the cheapening of products to bring them within a wider range of consumers, and it has made the drawing of tough, alloyed materials commercially feasible. Metallic cloth will exemplify the cheapening of a once expensive product. The raw material for this is copper, or aluminum, whichever is the cheapest at the time of manufacture. The copper is drawn to .012 or .013 of an inch in diameter, coated with silver and then drawn again to .002 of an inch and burnished. A similar process, without the coating, is used for aluminum. The finished wire reels up at a speed of a mile a minute. Starting with about 2½ pounds of aluminum, there will be some 30 miles of .004 inch wire 30 minutes later.

Tinsel, likewise, could not be a cheap product if it were not for high-speed operation. Tinsel starts as copper rod. This is drawn down to .012 of an inch, coated with silver, then drawn down to .002 of an inch and burnished. The shiny wire is then rolled flat. Here again, aluminum replaces copper when the cost of the latter rises to a point to make it uneconomical.

The foregoing examples afford some idea of what high-speed drawing means and what an accomplishment it is to be able to take rod and turn it into miles of true-to-gage wire. Wire mills are loath to reveal their best operating speeds for competitive reasons, but their secrets are usually general knowledge. Take .004 inch copper wire as an example. Drawing speeds are customarily between 2500 and 4000 feet a minute; however, some concerns have been able to reach speeds of 10,000 feet per minute and that's close to two miles a minute.


A man-sized job for wire in the form of husky ropes, co trolling a steam shovel for high-speed, dependable operatic

Emphasis upon speeds should not cloud the fact that there is another factor of equal importance. High speeds are attained with extraordinarily close tolerances. Without accuracy the speeds would be a liability, resulting in heavy rejections and economic loss. Today an item such as steel screen-cloth wire .010 of an inch in diameter can be drawn with a tolerance of .0003, with a 96.6 percent decrease in rejections over the old-style steel die, and 130 times more poundage can be drawn before changing dies.

CEMENTED carbide dies, being many times harder than the best steel dies, have made it feasible to draw phosphor bronze, other bronze alloys, and stainless steel. Now that they can be had in long lengths at reasonable cost, they are available for such products as screens and meshes where it is desired to use a non-corrosive material. We now find stainless steel wires being tried out for Fourdriniers on paper-making machinery and in the form of rope for ship rigging where resistance to the action of salt water is desired.

Copper is commonly thought of as the one metal suitable for electrical conductors, but there are other metals being used in wires for this purpose. In Mexico and Canada, aluminum is being used for telephone wires. While the conductivity is not as good as copper, aluminum requires fewer poles for support and it

is figured that savings in cost of installation offset the poorer conductivity.

Efforts to obtain wire combining high conductivity with strength have resulted in two products not widely known outside the trade and the technical world. One of these is a combination copper and steel wire; the other a beryllium-copper alloy. The former is not brand new, but has recently attained a commercial success that warrants its mention here. The latter is just coming to the fore.

EARLY attempts to combine copper and steel failed because electro-galvanic action took place wherever a poor bond permitted the entrance of moisture. To avoid this hazard the newer process calls for welding the copper to the steel. A beginning is made by placing a cleaned and fluxed billet of steel in a mold, leaving a uniform space between steel and mold. This is placed in a furnace and heated to a high degree, then molten copper is poured into the mold around the steel. The resultant ingot, nine inches in diameter, is hot rolled to form a rod ⅜ of an inch in diameter, and it is then ready for drawing.

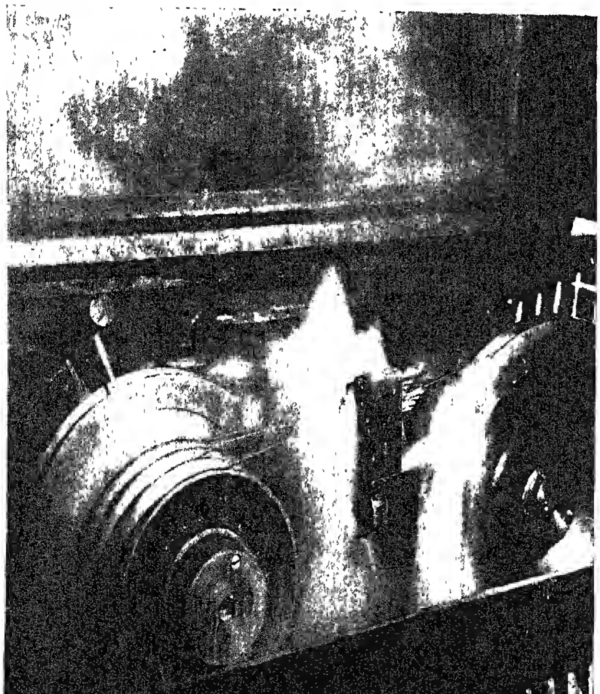
An interesting fact about this process is that the proportion of copper to steel remains the same through the rolling and drawing operations and is, therefore, under strict control. The wire so formed has the strength of steel in its core and the corrosion-resistant properties of copper for its sheath. It can be used wherever the combination of qualities makes it desirable, and that carries it into a great number of fields. It goes even into barbed wire and fencing where conductivity serves no purpose but where long life is desired.

In striving to obtain greater strength with the high electrical conductivity of copper, research has brought forward beryllium-copper, which is copper containing 2 to 2.5 percent beryllium. Having the best conductivity of any copper alloy, this new product enters into the production of many things. It has been found to be excellent for precision springs and for certain applications it has replaced phosphor bronze.

The development of more and more special wires is only one of several indications that the industry has advanced far beyond the age when wire was a simple product, to enter into a new era in which products must meet rigorous specifications for each and every purpose to which they are put. With the slow passing of traditional ways, the metallurgist has assumed a more important place and demands to know chemical composition, crystal structure, physical properties, and the surface condition or finish. Wire-making control begins with the billet and is not relaxed until the desired product is brought forth.

Safe operation of building elevators demands unfailing service from groupings of wire ropes

Credit for giving the impetus toward more scientific control of manufacture can be given to the automobile industry. It was, perhaps, the first to set severe specifications and to demand that they be met. Automobiles make large use of wire. Valve springs are most exacting in their requirements because they must have proper vibration frequency and withstand severe heat. Every tire consumes about four pounds of bead wire and this, too, is an exacting wire to make. Then there is spoke wire, used in great quantities a few years ago when wire wheels were in vogue. Bolts, machine screws, and rivets begin as wire, and if we accept the wire mills' definition of wire, we must include all cold-drawn shapes.



Drawing copper wire from rods at the rate of 2500 feet per minute on a continuous machine. One of several wire-reducing dies performing in a cooling bath

THE effect of this demand to produce uniform, quality products has to some extent increased specialization where it was already far advanced. There are mills devoted to the manufacture of screen wire and screens; others which make nothing but carding wire for carding brushes. Then there are many highly specialized processes for drawing such wires as tungsten alloys for lamp filaments and molybdenum for thermionic tubes. In recent years there has been an enormous growth in demand for welding wire coincident with the enormous development of welding technique. The 1935 Census of Manufactures tells us that nearly 14,000 tons of this wire was produced, and that does not include electrodes. Almost the only product escaping the newer specialization is nails. There are mills devoted to nail manufacture but for the most part nails are a by-product, being made from re-

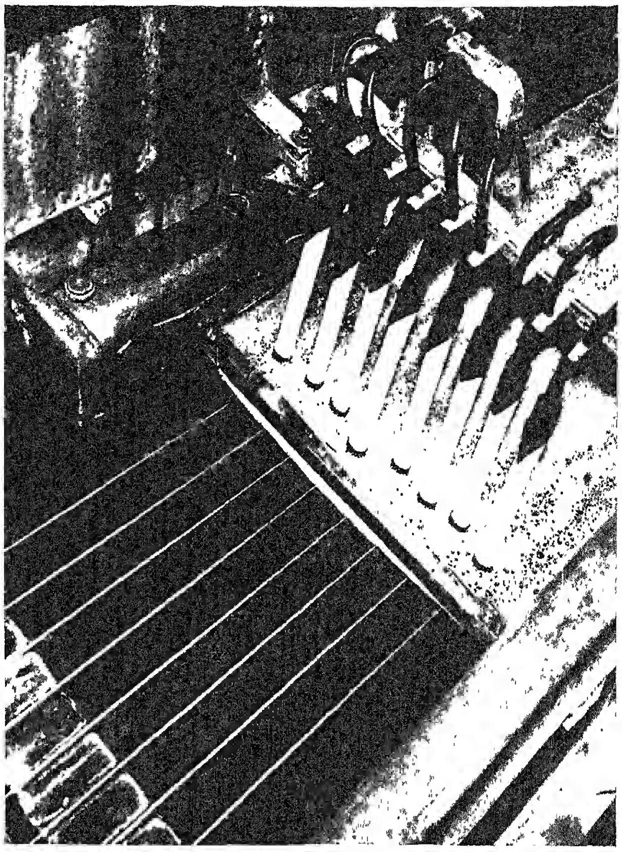
jected wire—the scrap of the wire mill. Such use of rejected wire to make an important by-product reduces the overhead charges appreciably, with resulting benefits to the consumer of the primary product.

Even as modern wire manufacture begins with scientific control of the properties of the billet, so it is that research carries through to the very end and the end is the surface finish. This applies particularly to galvanizing, a most important surface treatment, because galvanized wire is consumed by millions of tons annually.

If one were to cast about to discover where the greatest wire mill research activity was centered, it might well be in this field of galvanizing. A few years ago the electro-deposition process of coating wire with zinc became a practical commercial reality and immediately precipitated a host of studies seeking to improve all galvanizing processes. So much work has been done and so many processes have been developed that to describe them all is impossible. Here we can only touch upon the main points and make comparisons between the old and the new.

THE aim of research has been to improve the bond between the zinc and the base metal, and to obtain a more uniform and heavier coating. A defect of the old hot-dipped wire was the tendency of the zinc to separate from the base upon twisting or bending. Such an effect might be produced in weaving the wire into fence. Another weakness was its uneven and impure coating which resulted in ultimate destruction of the wire when exposed to the elements and especially to sulfur gases which are present everywhere. A fence, for example, was no more durable than its weakest point. When attempt was made to increase protection by applying heavier coatings, it could be done only by sacrifice of durability.

There are two paramount requirements for good galvanizing. It is essential that the uncoated wire be in a perfectly clean state to promote the bond, and it is necessary to use zinc of the highest purity. One of the refined hot-dip processes calls for passing the uncoated wire through a bath of molten salts which contain carburizing material to act upon the surface of the wire. The electro-galvanizing process we are about to describe tackles it another way. The wire is cleaned electrolytically by passage through a bath of molten caustic soda.



Electro-galvanizing eight wires simultaneously by passing them through an electrolytic solution. Electrical connections, above, are immersed in the solution

Flat wire, for which there are many uses, must flex without injury

The electrolytic process is very complex and the product of long research. The raw material is a roasted zinc concentrate, containing about 55 percent of zinc and more than two dozen other elements, present as impurities. The concentrate is fed into tanks of sulfuric acid to make zinc sulfate which is then subjected to several purifying processes and passed to the plating cell, ready for coating the wire.

THE plating cell may handle eight or twelve wires, depending upon its size. A current of 15,000 amperes is used and the density ranges from 400 to 700 amperes per square foot of surface to be plated. The voltage is about four. It is in this cell that the final purifying process takes place, because as the wire passes through the zinc-bearing solution, supported on glass rods, the zinc alone is carried to the wire by the electrolytic action.

Actually, this newest galvanizing process permits the closest control because the weight of the coating is determined by the speed of the wire moving through the solution, while uniformity of coat is controlled by running at a constant speed. Since very heavy coatings can be applied and still retain ductility and toughness, the product can be used where before only light coated wire was practical, and for purposes hitherto barred.

If one were to examine this process in full detail, study the complex chemistry of it, and see what rigid laboratory control must be exercised to make it work, one would begin to appreciate what scientific research means to the advancement of this industry. Research now permeates the industry to create a new era and there is still much to be done. Just as the steel industry has moved toward the manufacture of special steels for special purposes, so the wire industry perfects its processes to produce "tailor-made" wires.

Photographs courtesy: American Steel and Wire Co., Bethlehem Steel Co., John A. Roebling's Sons Co., and The Vaughn Machinery Co.

# LEGS

By S. F. AARON
All drawings by the author

THERE are no characteristics of animal life, however essential to the struggle for existence, that show such a variety of forms as the means of bodily progression. The varied development of locomotory appendages displays the most complete evidence of natural selection. Wings, fins, movable scales, and pliable segments have generally distinct developmental relationships to legs in the vertebrates, but in those creatures without backbones and having external or exo-skeletons (the arthropods, which include the insects), wings are but separate extremities of the thorax.

In the vertebrate animals, wings are nothing more than modified legs, as evidenced by their bony structure. In all animals they are levers of the first and third classes, with the power and fulcrum often very close together in comparison with the resistance. This is most noticeable in the grasshoppers, where more than usual power is required. In the invertebrates, legs are more numerous, in order to give firmer hold on all surfaces, and there is a wider range of uses besides those of locomotion.

The various uses of legs are often surprising to those who have given the subject little attention. Locomotion has probably been a primary cause of development, following which in succession have been modifications made in order to allow for special means of protection. Therefore there has come about, in addition to that of running, the power to leap, climb, strike offensively and defensively, to seize and to trap victims.

IT goes without saying that, as a means of escaping from enemies or in the pursuit of prey, the attainment of leg power has been of first importance, resulting in the perpetuation of many creatures, but not in all cases absolutely necessary. With the higher animals it has reached its present limit of speed probably in the prong-horn antelope, some Old World gazelles, at least one member of the Canidae such as the fox, that notable member of the Felidae, the cheetah, the larger hares, and the ostrich. The jerboas of the Old World, the kangaroo rats of western America, the kangaroos and wallabies and, exceeding all in proportion, the jumping mice, are the champions in leaping. In muscular strength probably the wolverine, the badger, and other members of the weasel family excel among the mammals, but are hardly more muscular than turtles and tortoises. The squirrels give the monkeys a close race for supremacy in climbing. In these frequent contests, the prizes for which are a full stomach or a continued existence, it may be noted that, however swift the predatory animals have become for the purpose of overtaking their prey, the potential victims have always managed to exceed the killers by a small margin. This is nothing less than self-evident in the nature of development, for a predatory animal may find other means of catching its prey and therefore continue to exist, while speed, at most, may be the only means of escape and perpetuation may depend wholly upon the ability of the hunted creature to get away. Leaping and climbing also carry the same conditions for sustenance and protection; in this also the creatures preyed upon are superior to their enemies.

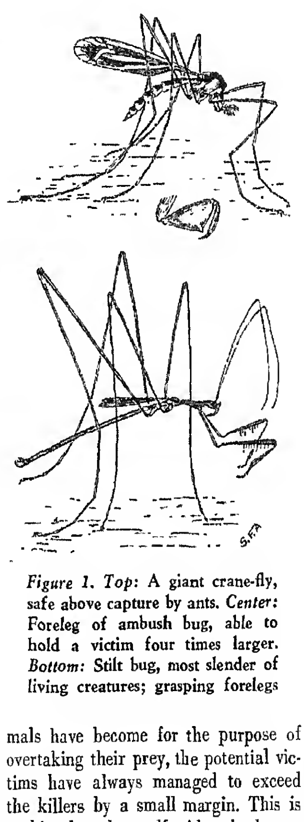


***Figure 1. Top:* A giant crane-fly, safe above capture by ants. *Center:* Foreleg of ambush bug, able to hold a victim four times larger. *Bottom:* Stilt bug, most slender of living creatures; grasping forelegs**

As a slight digression it may also be here remarked that the same thing holds in speed of wings: many of the birds preyed upon, such as the plovers, snipe, and sandpipers, the fly-catchers and warblers, many sea birds and the swallows and swifts, by long odds can exceed the hawks and falcons, the speed of the latter having long been exaggerated. Only the swoop of the gyrfalcon and duck hawk, with the frequent strategy of approaching flocks unaware, enable them to overtake swifter victims.

In muscular strength that of the invertebrates so greatly exceeds all the backboned creatures as to make the comparisons almost ridiculous, but proportionate weight must be considered.

The development of claws for perching, climbing, and seizing victims has been extreme in the evolution of legs, not strangely keeping pace in the case of predacious creatures with the canine teeth—for example, in the cats—and with grasping jaws, as in the tiger beetles. Oddly, it has not proved analogous with, or as showing community of origin with, prehensile tails. For perching, claws have reached their highest development in the woodpeckers and parrots; for grasping, in the hawks, owls, parrots, and monkeys. In climbing, independent of grasping, the squirrels, woodpeckers, nuthatches, creepers, certain warblers, and lizards seem to excel among the vertebrates. With the insects, owing largely to the lesser relative weights, special developments greatly excel, as in almost all species, especially those Diptera closely related to the common house-fly, a few beetles, and the true bees, which have a greatly altered, fan-shaped claw called the pulvillus, enabling the possessor to walk on smooth surfaces and upside down.

THE development of leg muscles must of necessity match the power expended, and nearly always by comparison it indicates relative strength and special needs. The rapacious birds have unusually developed femora for grasping and driving their claws into vital organs, the deadly effect of which cannot be matched by any mammal or other bird. Cats use their canine teeth for killing, as do all carnivorous mammals with or without claws, and thus the birds of prey have a distinct advantage in not endangering their eyes when killing a victim that is capable of giving serious wounds.

Special development for offensive action and in seizing victims, while consisting principally of claws, has resulted in odd peculiarities among the invertebrates; the prey is grasped between the tibia and tarsi, one or both of which are armed with spines for the surer holding of the captive. Examples of this are the praying mantis, certain assassin bugs and that odd form, the Mantispa.

Leg spurs above the feet in certain male birds are both offensive and defensive and, as is well-known, occur among gallinaceous species and some-

times, in modified form, among the females.

Defensive leg development among the insects and their allies generally consists of extreme length, by which the possessors are lifted above the attack of many foes. Examples are the crane-flies (Figure 1), mosquitoes, gnats, the long-horned grasshoppers and walking-sticks, the mantis, the Emesa or stilt-bug, many syrphus and bee-flies, the Meloe and the Spanish-fly among beetles, many non-stinging, parasitic wasps, as well as the ants in general, though some of the latter among the smaller forms have relatively short legs. The solitary true wasps of "the stinging sorority" may be said to use their long legs both defensively and aggressively, as do also many species of ants and notably the ground spiders that spin no web snares, but seek their prey in the true hunter manner, escaping also from such predatory insects as assassin-bugs and Carabid beetles by both retreat and height.

When an ant or an assassin-bug encounters a crane-fly, it finds only several towering, thread-like extremities that mean little in the way of meat or blood juices and the sought-for prey is alarmed and takes its leave. The peculiar stilt-bug above mentioned (Figure 1) has proportionately the longest pedal extensions known, and this is the more remarkable because the body of the insect is also exceedingly long and slender. This perfect defense permits the creature to invade spider webs and to evade the rightful occupant. The stilt-bug feeds on the insects caught in the web before the spider finds them. The bug is doubly endowed for seizing these struggling victims by having its delicate, spiny, pincered forelegs developed as in the mantis.

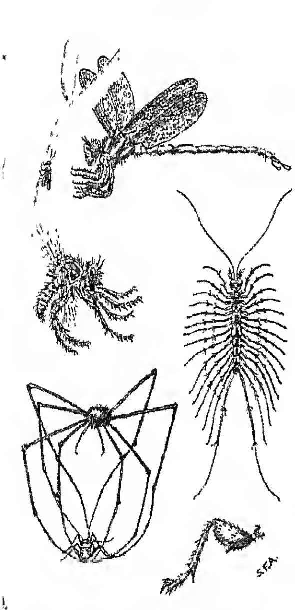


*Figure 2:* The dragon-fly's insect-catching legs. Robber fly pouncing on a victim. Caging legs of a centipede. Daddy-long-legs snaring its surrounded prey. Leg of boll weevil

Among the quadrupeds—and unlike spiders, insects, and millipedes—length of leg commonly means speed and nothing else; there is an exception where another purpose is employed—that in which the giraffe reaches the mid-height foliage of trees, correlating his neck in the act. Among the birds the many exceptions are the waders.

In seizing their prey, predatory vertebrates are especially endowed by extremely powerful adductor muscles aided by the coracoid bone as a brace to afford gripping by the claws.

Used as traps, by the arthropods alone, legs are both specially endowed or are but occasionally so employed. Predatory daddy-long-legs surrounds its prey with its eight long limbs like a cage, drawing them together so that a victim, not very small, finds escape cut off, as from an inverted basket (Figure 2). Scorpions also practice this act and the hunting spiders either do it purposely, or their legs naturally surround the prey upon which they leap. The peculiar attachments of the legs of the dragon-flies (Figure 2) are notable; the thoracic segments holding the three pairs are so proportioned as to bring each succeeding pair below the anterior ones. Thus, all are forward-reaching to about the same length, forming a basket of six claws to encompass small gnats, moths, beetles, and so on, taken on the wing or when perched.

RETURNING to the subject of speed, it is among adult insects and those of medium length of leg that we find the remarkably rapid runners, while those with very long legs are generally slower in all their movements than those with exceedingly short legs. Length of legs, then, is obviously for other purposes than speed, as has already been shown. While ants are swifter than the fastest racing car, in proportion, those of the spiders that travel about move much faster, even when spinning a thread behind them, than ants or ground beetles. The latter, such as the carnivorous Carabids, rival the ants. Roaches also are sprinters of the first rank.

The leg muscles of leaping insects are naturally enlarged, as may be observed among the grasshoppers (Figure 3), flea-beetles, and fleas. There is not the marked difference between the members of the kangaroos and the many mammals that do not leap that there is between the grasshoppers and insects that do not leap. But running seems to be more a matter of muscle and control than of relative size; thus the ants and ground spiders (Figure 3) move far faster than the flies, true bugs, and most beetles, and yet show little or no external difference in leg development. Femoral development accompanies lifting strength.

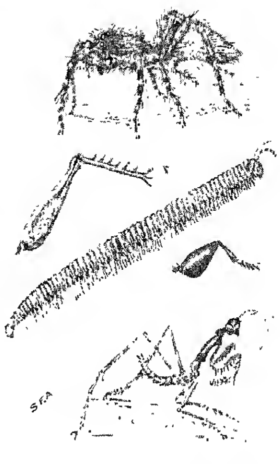
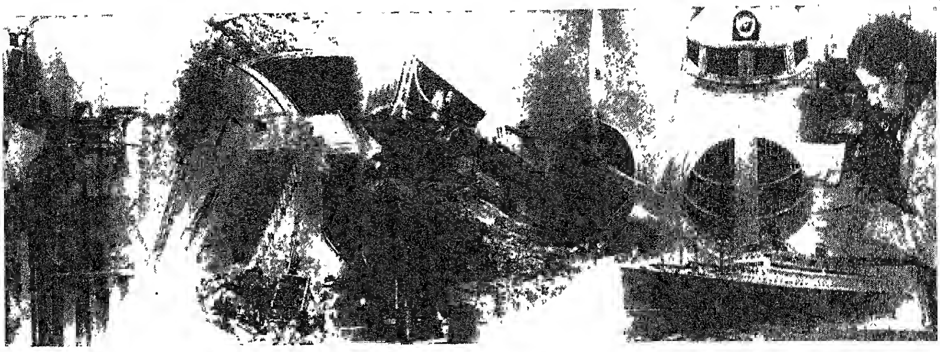


*Figure 3:* Ground or wolf spider, proportionately swiftest of all running creatures—about ¾ inch long. Hind leg of grasshopper. A diplopod (thousand legger); though its 58 segments bear 96 pairs of legs it moves like a turtle. Hind leg of flea-beetle, enlarged; its leap is over 200 times its length. Young of praying mantis. Note forelegs

Most remarkable concerning leg development is the voluntary release of muscular attachment as a means of escape, common alike with spiders, grasshoppers, a few species of other orders, and not a few lowly vertebrates, such as lizards and salamanders. This is also a characteristic of the caudal appendages of these latter creatures and some snakes. When seized by an enemy, the muscular attachments, often capable of great power, instantly become detached and the enemy is left with but a leg to satisfy its appetite, while the rightful owner escapes, very shortly to grow another leg. This operation has been timed with lizards and it was shown that, within a few weeks, the creature that was bereft of a right hind leg grew and perfectly ossified 26 bones, also as many distinct muscles and muscular attachments. There is less complication in the spider and grasshopper legs, though sufficient to make the rebuilding in even a shorter time astonishing.

Other useful characteristics of insect legs are the spines on the tibia and tarsal joints of insects and their allies, best developed in the leaping Orthoptera: both the long and short-horned grasshoppers. Though their very evident use is apparent, they have not been fully appreciated by many students. These spines are merely aids to the resistance of the leg against any fixed object; they also give the insect a firmer footing, especially when leaping, the spines often catching in grass and stems when the slender tarsal claws, set for perching, will allow slipping.



# THE SCIENTIFIC AMERICAN DIGEST

**Conducted by F. D. McHUGH**

**Contributing Editors**

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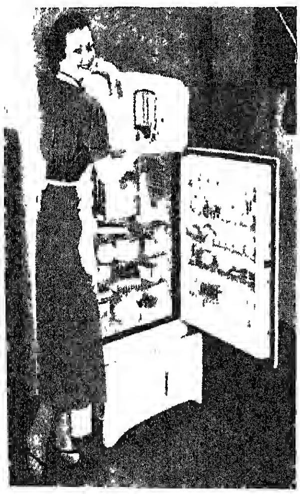
Chemical Engineer

## Musical Refrigerators

IT has been said that 60 percent of a housewife's time is spent in the kitchen. Now by having a Crosley Shelvador refrigerator with a radio built in its top, the housewife may listen to the radio programs she wants, while she works. Most radios are placed in the living room which is two or three rooms away from the kitchen, and the housewife either has to miss the program when she is in the kitchen or turn up the radio in the living room so loud that it will ordinarily drive everyone out of the house.



Refrigerator-radio combination

The radio is installed in the front of the refrigerator top, and its dial fits in the space where the escutcheon is ordinarily placed. The dial frame and knobs are all chromium to match the hardware on the refrigerator, yet the radio is in no way connected with the operation of the refrigerator.

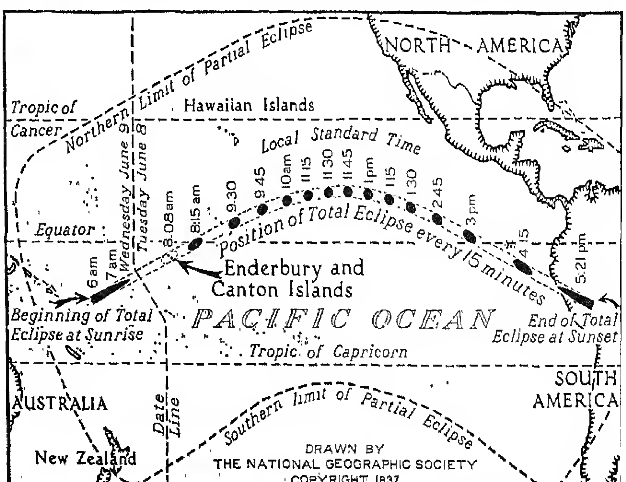
## Longest Total Eclipse of Sun in 1200 Years

THE two ends of the path along which the shadow of total darkness will move in the eclipse on June 9th and 8th are shown in the accompanying chart by the small arrows; the path itself, by the light, broken lines and the elliptical and round spots.

The large arrow shows Enderbury and Canton Islands of the Phoenix group, on one of which the party of American scientists to be sent by the National Geographic Society and the United States Navy will set up their instruments. These islands are the only spots of land directly in the path of the total eclipse at a time of day when the sun will be high enough above the horizon for good observation—roughly between 22 and 23 degrees. At these islands the total eclipse will last about four minutes. Near noon, the total darkness will last for more than seven minutes—almost the longest of possible eclipses, and the longest that has occurred since 699 A.D. But no observers will be able to take advantage of this extraordinarily long period, for the shadow will be 1500 miles from the nearest land.

The black spots on the map represent the actual shape and size (to scale) of the shadow, during the eclipse, every 15 minutes, at the standard times indicated above them. The times shown on the map seem to vary from the 15-minute intervals because the shadow sweeps through nine of the standard time zones, each differing by one hour, into which the earth's surface has been divided for ease in time-keeping. The shadow will cross the International Date Line as shown, early in the morning. As a result of this crossing the eclipse will have the rather uncommon experience of ending the day before it begins.

The unusual duration of the eclipse—more than seven minutes at its greatest—is due to the fact that it occurs near July 1, when the sun is at its greatest distance from the earth; that it occurs at a time of the month when the moon is closest to the earth; and that the shadow falls near the equator.

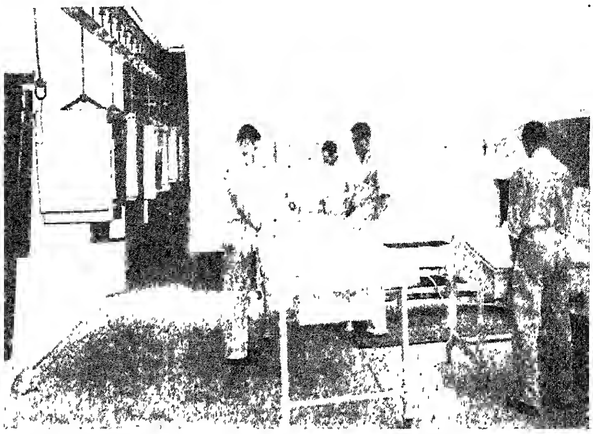



Path and time of the total eclipse of the sun, June 9 and 8

## Synthetic Decane Fuel

IN the search for fuels to be used in aviation engines of high compression ratios, recent investigations have led to the study of synthetic compounds containing 10 carbon atoms. It has been found that compounds of hydrogen and carbon which contain branched instead of straight chains of atoms are the most efficient constituents of high compression fuels. The iso-octane used as a standard in rating octane numbers of fuels is such a branched chain compound and is known chemically as 2, 2, 4, trimethyl pentane. Recent investigation has shown that the decane containing 10 carbon

atoms, derived from dimethyl ethyl carbinol, is even better fuel than iso-octane when used in engines of very high compression ratios. This compound, which is called iso-decane, is presumably tetramethyl hexane. In tests it shows no knocking at compression ratios of 11 to 1, and by the addition of tetraethyl lead its anti-knock characteristic can be extended as high as 13 to 1. (The average compression ratios in present automobile engines is about 6 to 1.) The efficiency increase through the use of such very high compressions is substantial.—*D. H. K.*


Whiteness of white is checked accurately in this color-matching room

### AGING ROCKS

RAW cuts through rock in the construction of a highway near Carlsbad, New Mexico, looked too glaringly new, so National Park Service officials applied copperas to give a yellow tinge to the fresh cut rock, and spread road oil over that.

## No Illusions in Color Matching

TO manufacturers of white porcelain products, there are as many degrees of whiteness as there are shades of blue. Many factors difficult to control in the manufacture of porcelain enter into the whiteness of the product, making unavoidable variations in color. Unless all the panels used on a refrigerator or range are carefully matched the difference in color is noticeable to the purchaser.

Many methods for inspection have been employed but the "tunnel of light" recently installed by Westinghouse at Mansfield, Ohio, is the most effective yet used. This room has no corners, employs combination incandescent-mercury lighting with an effective intensity of 114 foot-candles, and is shadowless so that even curved surfaces may be compared effectively against standard colors. This color-matching booth has been termed one of the most efficient lighting systems for color matching in the world.

Previous to the installation of the "tunnel of light," rejects were at least 300 percent higher. During the peak months of 1936, color rejects found on the assembly floor were less than 1 percent.

The room is designed to eliminate shadows and provide a high intensity of diffused, even lighting. If a pencil were placed anywhere in the room, there would be no visible shadow cast from it. None of the inspectors wear anything other than white uniforms. Every precaution against optical illusions is provided in this modern inspection booth.

The lighting is supplied by 28 300-watt incandescent lamps and 11 400-watt mercury-vapor lamps, making a total of 12,800 watts with an average light intensity of 114 foot-candles. The lamps are so alternated, spaced, and shielded as to give the maximum efficiency. As shown in the illustration, all pieces pass through the booth on conveyors and are compared with three commercial standards. The inspectors are all required to report to an eye specialist for eye tests periodically.

On flat ware, the pieces are checked on the color-matcher which is shown on the table. All panels with large radii, however, are checked with the color standards. The man at the end of the table on the right-hand side checks the enamel for thickness on an electro-magnetic gage. On range parts any enamel that is over .018 of an inch thick is scrapped inasmuch as enamel over this thickness would chip readily not only in the assembly but in transportation and after it had been installed.

## "Mechanical" Stock Exchange

A PICTURE of peace, calm, and orderliness is presented by the main trading room of the Stockholm Bourse, or Stock Exchange, where all transactions are carried out mechanically. The brokers sit comfortably in their chairs; desks equipped with push buttons are before them. If they want to make a selling offer, they press a button of one color, and all their fellow members instantly see the price they ask. If they wish to purchase at a price noted, or offer a different price, another button announces their intention.

All goes quickly and as if by clock work. There is none of the frenzied shouting of other exchanges, where the strongest lungs have the advantage in times of keen bidding. Each bid is registered in its proper order, even if the difference in time of pressing the respective buttons may be but one hundredth of a second.

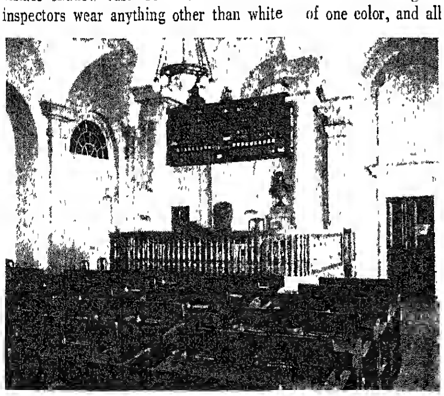
The installation was designed by the Swedish L. M. Ericsson Telephone Company, which has delivered similar models to stock exchanges in other cities. Thanks to this smooth working machinery, stocks valued at about 2,000,000 kronor change hands each day, the average yearly turnover being 600,000,000 kronor.—*Holger Lundbergh.*

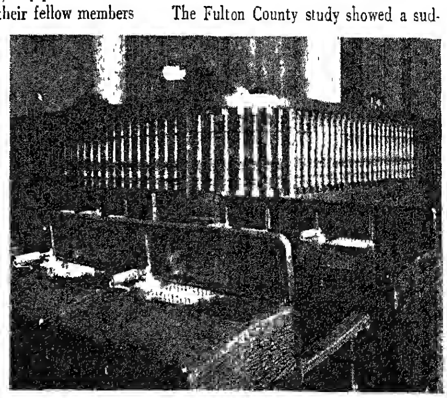
## Importance of Hush-Hush Plague

THE seriousness of syphilis from a dollars-and-cents standpoint has been proved in Fulton County, Georgia. A study of syphilitic and non-syphilitic persons on the relief rolls of that county has been made with federal funds, and Dr. J. C. McDaniel of Atlanta reports the results in the *Journal of the American Medical Association.*

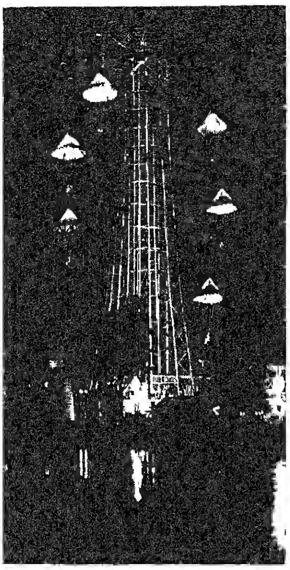
About 34 percent of the Negroes and 7 percent of the white persons on the county relief rolls are syphilitic. Of that number 17 percent between 20 and 40 years are not able to do competitive work. Sixteen percent of those past 50 years are not able to work at all.

The Fulton County study showed a sud-





Mechanical bidding in a stock exchange. *Left:* The board on which bids appear. *Right:* The members' push buttons



Night view of a parachute tower in Chicago, where over 70,000 persons made safe drops in a single season

den drop in the number of the syphilitic between the ages of 39 and 60 and over. This rapid decrease means one of three things, according to Dr. McDaniel—the people died, have been treated, or are not able to report for examination.

No orderly train of symptoms could be found resulting from syphilis in the Fulton County study.

"There is no disease that I know of, found among such large numbers, that responds so beautifully to treatment as does syphilis, nor can I think of one that has a longer latent period before serious symptoms manifest themselves, thereby affording a golden opportunity for diagnosis and cure or at least an arrest of the disease," Dr. McDaniel states.—*Science Service.*

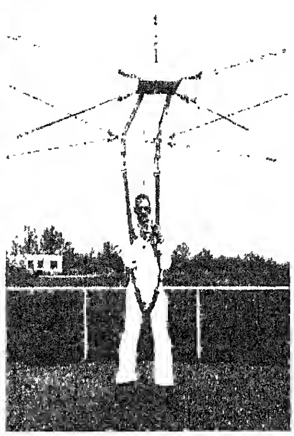
## Training for Parachute Jumps

THE Commanding Officer of the Lakehurst Naval Air Station gave an excellent rating to parachute jumping towers for training men in this difficult activity. Accordingly, we have secured a first-hand account of this novel device and its uses from the President of "Safe Parachute Jumps Company."

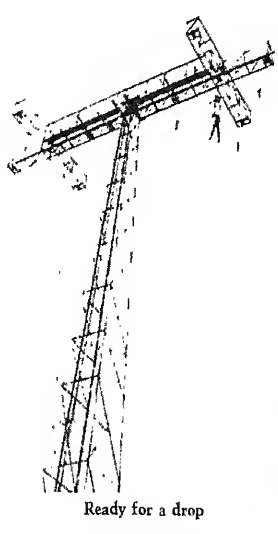
In military or naval aviation the parachute is regarded as an absolutely indispensable safety device, yet training in parachute jumping is haphazard, and the average pilot is apt to know but little regarding the 'chute. The parachute is something to be strapped on with a harness, the rip cord something to be pulled after making a jump. That is perhaps the sum total of his knowledge. How to land correctly with a 'chute and how to avoid injury in so doing are mysteries to the novice. Instruction is apt to be confined to the reading of printed instructions and the mind of the jumper is likely to become confused when the critical moment arrives. When more intensive parachute training is attempted, by a pull-off or free jump from a plane or a "blimp," there are hazards and expense.

With these thoughts in mind, James H. Strong spent more than two years in developing a system of training which would be free from these objections, and finally developed the parachute tower and specially devised guides.

The parachute tower, as illustrated in our photographs, is 250 feet in height. From cross arms at the top of the tower vertical guide cables extend to the ground. A large size parachute is secured around its skirt to a spreading ring, so that the 'chute is kept permanently open. The ring, in turn, is secured to fittings that move up and down the guide wires. In the peak of the parachute a special fitting engages the 'chute with a



Harness and hoisting rig



Ready for a drop

hoisting hook, centrally located with reference to the guide wires. Below the parachute the regular harness is replaced by a very comfortable swing. With this simple yet entirely effective apparatus, the training proceeds in four phases.

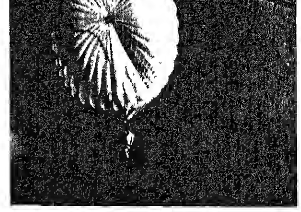
*First Phase:* The student sits in the swing with his feet well off the ground. He is strapped securely into place, and hoisted with his parachute to the top of the tower. Then the parachute is either detached manually by the student from the hoisting hook or is automatically released. As the fabric is spread out by the ring, the 'chute fills with air immediately, and supports the student comfortably on the descent. Just before the ground is reached, arresting and shock-absorbing gear comes into play, and stops the downward movement of the swing in gentle fashion. The occupant's feet never come into contact with the ground. The student soon realizes that because the parachute is permanently open and because of the absorbing gear, he is at no time in any danger whatsoever. The first ride or drop is a sensation. After a few drops the novelty wears off. The student begins to study the rate of descent and to estimate exactly when he would strike the ground if he were wearing a harness. Soon he is ready for the second phase.

*Second Phase:* Now the swing is replaced by a regular harness, and the student learns to relax and to cushion or "shock-absorb" his landing with legs and feet. Several drops in this fashion teach him the lesson thoroughly.

*Third Phase:* Here a tower is employed, provided with a rotating boom, which is "trimmed" down wind. The hoisting cable passes over a sheave at the outer end of the boom, so that the 'chute is at a maximum distance from the tower. The peak of the 'chute is still engaged by a hoisting ring, and the skirt still secured to a spreading ring. But in this phase of training, when the 'chute is released, it trips itself clear of the spreading ring, drops through the ring in a "filled" condition and drifts down wind, clear away from the tower. With his previous experience, the future member of the Caterpillar Club is able to take full advantage of this third phase, which gives him precisely the experience of a jump from an airplane but with far greater safety. The instructor stands at the bottom of the tower and notes errors. The student rapidly learns how to land correctly and safely.

*Fourth Phase:* Now the student drops with a closed pack, instead of the open 'chute, and can pull the rip cord within a fall of 75 feet. When the rip cord is pulled, air fills the 'chute, and the shock load is taken on the canopy but, because of a special harness, not by the jumper. The descent thereafter is perfectly normal. If the jumper does not pull his rip cord within a fall of 75 feet, automatic safety features come into play. After several jumps of this nature, the student learns how to time the rip cord so as to open the 'chute when it is clear of all obstructions. He is now thoroughly ready to jump from a plane or a "blimp."

There is not the slightest doubt that this training removes physical danger, but, what is more, it robs parachute jumping of its attendant fears. It is not surprising that the



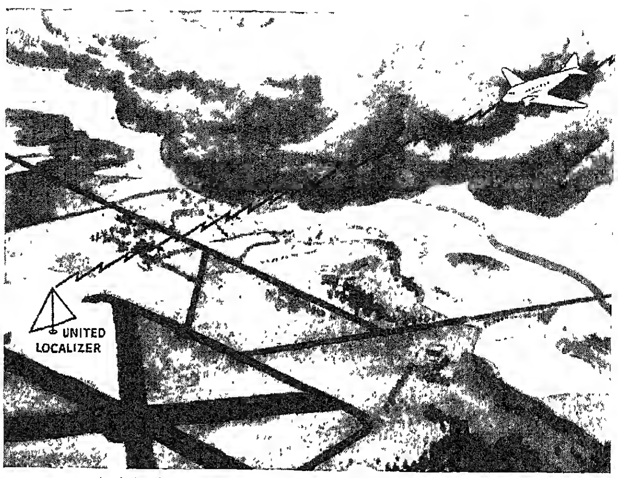
An open 'chute after it has been tripped clear of the spreading ring

navy men at Lakehurst are all being given this form of training, nor is there any reason why civilian pilots should not take advantage of the same training system.—*A. K.*

## Radio Signposts for the Airport

A NEW radio range system, providing positive radio identification of airport location, has been developed by United Airlines and placed in service in several cities on its transcontinental airway.

The radio localizer, which is shown diagrammatically in one of our illustrations, uses a novel triangular "umbrella" type antenna. The localizer beam intercepts the regular radio beam some thirty miles from the airport and provides identifying code signals. The pilot follows the local beam till he is directly over the landing field. It is claimed that the triangular shape of the antenna eliminates any distortion of the path of the beam by weather conditions. At the same time, the new beam does not interfere with voice transmission.—*A. K.*



Artist's drawing of a new radio range system for aircraft

## The Case for the Bespectacled Pilot

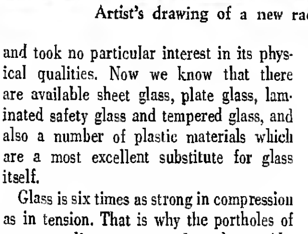
THE pilot with spectacles finds it hard to get a job. Yet Francis Chichester, writing in the *Aeroplane* (London) makes a strong plea for their usefulness. In a closed cabin machine the difference between a pilot with perfect eyesight and one whose eyesight is made perfect by wearing glasses is evidently nil. In open cockpit flying, Mr. Chichester thinks that the flier accustomed to wearing spectacles actually has advantages over the pilot who needs no glasses, because (1), he is accustomed to wearing spectacles and will therefore handle goggles more efficiently; (2), in bad weather water is just as distorting on goggles as on spectacles, but where goggles fog spectacles rarely do so, and a pilot can look out of a cockpit at 150 miles per hour if his eyes are protected with spectacles; and (3), shortsighted pilots see better in the dark.

We do not necessarily agree with all of Mr. Chichester's arguments, but there is evidently hope for the shortsighted man who wishes to make flying his career.—*A. K.*

## Transparent Materials in Airplane Construction

GLASS technology has made great strides of recent years. Once upon a time we used to think of glass as just glass, and took no particular interest in its physical qualities. Now we know that there are available sheet glass, plate glass, laminated safety glass and tempered glass, and also a number of plastic materials which are a most excellent substitute for glass itself.

Glass is six times as strong in compression as in tension. That is why the portholes of our ocean liners are curved on the outside. They are then much stronger than would be flat windows or windows curved inwardly. When we build the supercharged cabins of the future, with a higher pressure inside the cabin than outside the cabin, the question of glass strength will have to be carefully considered. With tempered glass, the thickness of a 15-inch diameter circular port will be about ⅜ of an inch. Ordinary glass would have to be ¾ of an inch thick, with a corresponding increase in weight. Soundproofing has to be considered with reference to windows; it is of little use to soundproof the walls of a cabin if the glass windows let noise through, and windows should be of laminated glass with a stiff plastic sheet at the core. Glass can also be curved in many ways, an essential requirement for the airplane cabin windshield.




*Above:* Note the curves in this Plexiglas airplane windshield and cockpit enclosure. *Below:* The same type unit installed in a Bellanca racing plane

The plastic substitutes for glass are strong competitors of the glass itself. A material such as "Plexiglas" has great toughness, strength, and a permanent colorless transparency. A photograph supplied by Rohm & Hass, the manufacturers of this material, shows how this material may be appropriately curved. The photograph of the Bellanca racer shows a beautifully curved windshield and complete cockpit enclosure for the pilot.

We never cease to marvel at the way in which all branches of technology are drawn into the service of aviation. Of course, aviation renders a reciprocal service to technology by postulating new and severe requirements in materials and manufacturing methods.—*A. K.*

## Aviation in the Public Schools

BECAUSE of the immense public interest in aviation, a great many of our public schools are teaching this subject in some manner or other, but we are not quite sure that this fashion in education is fully justified. Why not, for example, teach railroad engineering or naval architecture in the public schools? These subjects are not so novel or romantic as aviation, perhaps, but they are just as important in the life of the nation and just as capable of serving as a medium of instruction in applied science.

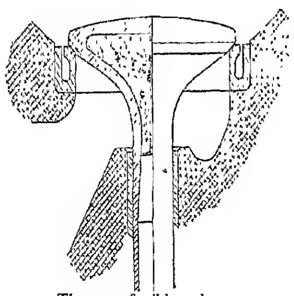
One very good reason why aviation should not be too highly stressed in the public schools is because the tendency is to imbue every bright boy with the idea that aviation may be his career, whether as a pilot or as an engineer. Thereby the pressure of young men seeking employment becomes too great even for this rapidly growing industry.

On the other hand, aviation is a fine medium of instruction in applied science, physics, mathematics, and in handicraft. Nothing brings out the wonderful possibilities of aviation in this regard more than the pamphlet entitled "Aviation in the Public Schools," by Robert W. Hambrook of the United States Department of the Interior. A small three foot diameter tunnel can be readily built on principles identical with those of the large scientific tunnels—in fact

and boys have co-operated successfully in building such tunnels. In such a small tunnel all the basic aerodynamic experiments can be performed, not with great accuracy but in perfect qualitative fashion. If a school has a class in woodworking, it is much more fun to build flying models than dull pieces of carpentry such as a book case. In some schools the boys have built and flown their own gliders. In the vocational high schools, fine instruction is given, fitting young men for work as airplane engine mechanics. Obsolete equipment such as planes and engines can be obtained by recognized schools on "indefinite loan" from the Army and Navy Air Services. So, with the above reservations still in mind, we cannot but admire the splendid and varied work in aviation that our public schools are undertaking.—*A. K.*

## Flexible Valve Seats for Aircraft Engines

THE valve seats in modern aircraft engines are made of the finest materials and are shrunk-fitted into the aluminum head with the greatest care and skill, but



The new flexible valve seat

the exhaust valve seat operates, of necessity, under very high and uneven temperatures. Such conditions produce valve-seat distortion, and the consequent valve leakage is one of the major causes of exhaust-valve burning in aircraft engines of high specific output.

Messrs. Heron and Beall, in a paper presented before the Society of Automotive Engineers, suggest a remedy, after four years' intensive research, in the form of a flexible valve-seat insert. As can be seen from the drawing the ring-shaped valve seat is made of such a form that the lip carrying the seating material proper (austenitic nickel-chromium valve steel) can yield radially outward under the valve pressure. In the conventional valve seating there can be no such yielding. This yielding should eliminate the bad effects of distortion, and the device should prove very useful.—*A. K.*

## Rock of Gibraltar on Wheels

ONE look at the new "rolling fort" of the Milwaukee Police Department should be enough to deter anyone with ideas about starting a riot, for this armored car is intended to be driven into a mob and used as a base of operations by the 25 policemen carried in it.

Built by Erlinder-Platt Body Corporation, the car is fully armored with aluminum and glass; convenient gun-ports are provided on

# TRANSPORTATION SECTION

be let down to the ground to protect the tires from gunfire. The lower edges of the body are rounded to prevent a crowd from overturning the 6800-pound car.

The outside skin is thin steel, under which are felt, hardwood, and finally a ¼-inch thickness of aluminum alloy. The glass is 1¼ inches thick and proof against bullets from side-arms and machine guns. A heavy steel shutter protects the radiator from bullets and damage, and the engine is housed entirely within the bus to prevent tampering by a mob.

## Ships Must Have Smooth Skins

SMOOTH outer surfaces for steamers is not a matter of beautifying, but a technical and economic requirement. It is only in recent times that we have acquired more accurate knowledge of the decisive influences of friction-resistance and a rough outer surface on the speed and commercial value of any vessel. All this was clearly set forth in a lecture recently given by Prof. Dr. G. Kemp, Director of the Hamburg Shipbuilding Research Station.

In connection with experiments made at the Göttinger Institute of Aeronautics, observations were made by testing the effects of various degrees of roughness on surfaces covered with sand of different degrees of coarseness. Certain general rules could be laid down, from which Professor Kemp was able to make tests at the Research Station and also on board several vessels, with respect to the resistance created by roughnesses on the ship's outer surfaces, including bent plates, uneven seams, and projecting belts and rivets. The astonishing result of the tests was that such roughness on the *surface increased the resistance no less than* 35 percent, even when the vessel was brand new, over that which would be experienced by a ship whose sides were absolutely smooth.

Therefore, a ship which has just been launched, makes about 1½ knots less if her outer hull is not smooth. In practice, this roughness also adds to the tendency for mussels, seaweed, and rust-spots to accumulate and increase, gradually damaging the ship's paint. The amount of sailing time lost in this way was also accurately estimated by Prof. Kemp, so that as a result of his scientific researches and experiments, the importance of having the outer surfaces of ships absolutely clean and smooth can readily be seen.

### RAILROAD BUYING

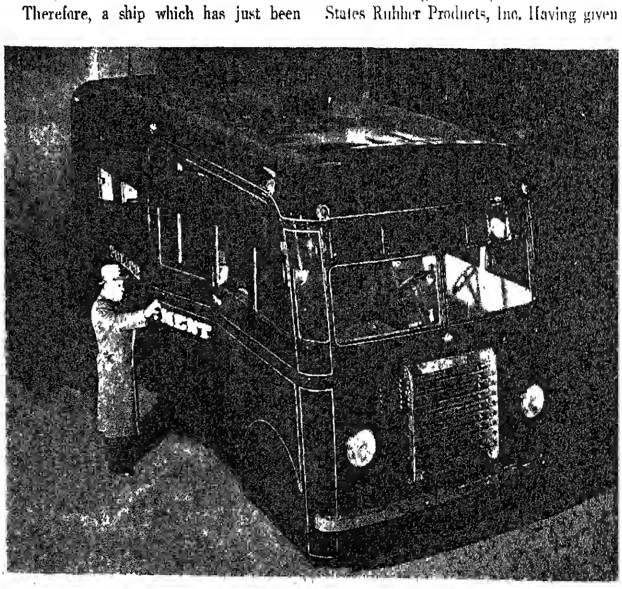
PURCHASING of fuel, material, and supplies by Class 1 railroads in the United States during 1936 totaled 803,421,000 dollars. This represents an increase of 35.5 percent above the purchases for 1935 and the total was greater than any year since 1930.

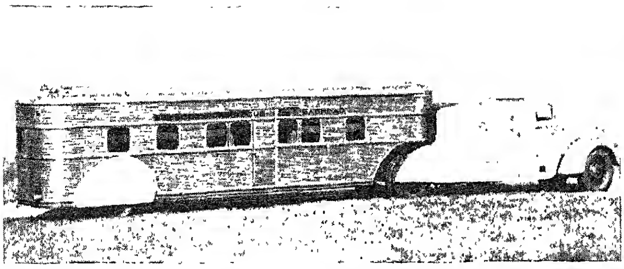
## Tires and Road Surfaces

THE tire engineer's life is just one problem after another. As soon as he builds a satisfactory tire, which is no easy task in itself, something else pops up to challenge him. Now comes a certain type of corrugated road construction to provide new worries.

This particular type of road is made by roughening the surface to give a better skid resistance for automobile tires. In many cases the roughening is done by running a cleated wheel over the road. The wheel leaves a pattern of rough marks at regular intervals. Now, this is well and good from the standpoint of safety, *but these regular* corrugations in the road surface cause vibration and noise as the car goes over them.

This situation has aroused considerable interest among tire engineers of United States Rubber Products, Inc. Having given





**The desert has no terrors for the new type desert trailer shown above. Constructed by the Edward G. Budd Company for the Nairn Transport Company, Ltd., this trailer, which will be used for travel in the Syrian desert, utilizes the same principles of construction incorporated in modern light-weight trains. It is of light-weight, stainless steel construction, has a capacity of 14 passengers, and is powered by a 150-horsepower Diesel tractor. Weight is 28,000 pounds, speed on the desert 65 miles an hour. The illustration below shows the comfortable dressing room and the lavatory, photographed through the rear door of the trailer**

quietness to that company's tires, they believe they also have a solution for the road problem. Furthermore, they believe that the solution is similar to the one they used in reducing tire noise. They found, in their research on tires, that much of the tire noise came from the regular impact of the tread blocks against the pavement. They reduced this noise by arranging the spacing of the tread blocks to break up the regularity of the impacts.

Therefore, they offer the theory that irregular spacings of the corrugations in road surfaces may solve the new obstacle to the quiet operation of motor cars. They point out that by a slight staggering of the road marks in a systematic manner it will be possible to break up the impulses transmitted to the car and greatly reduce the noise which now exists. And they predict that when both the road surface and tire treads have these irregular spacings, the whine or "pitched" noise which comes from regular impacts will be entirely eliminated.

**UNDER THE MEUSE**

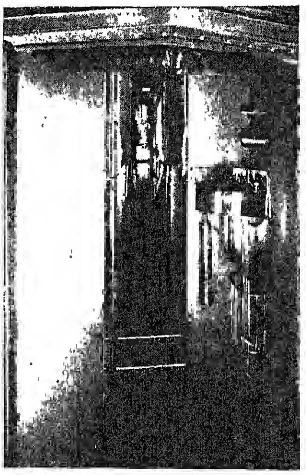
**HOLLAND is to build a vehicular tunnel under the river Meuse with lanes for automobile traffic, bicyclists, and pedestrians. Its cost will be 7,500,000 dollars.**

## New High-Pressure Locomotive Type Boiler

WHAT is thought to be the first high-pressure boiler ever made with welded barrel and dome, under U-68 (Class I) rules of the A.S.M.E. Code for fusion welded vessels, was recently completed by Farrar and Trefts, Inc., of Buffalo.

The new boiler is of locomotive type and is for use in oil fields. The barrel, shown in the accompanying illustration, is 16 feet 6 inches long, 62½ inches outside diameter, and made of steel plate 1.15 inches thick, electrically welded by the shielded arc process with equipment supplied by The Lincoln Electric Company.

Welded construction of the barrel eliminated a large amount of caulking of seams which was necessary with the former method of construction employing riveting. The manufacturer reports that the seams remain



permanently tight in the field, thus assuring freedom from maintenance. The two longitudinal welds of the barrel were hammer tested at 575 pounds and leak tested at 700 pounds hydrostatic pressure, revealing high quality leak-proof seams.

## Highway Foundation and Surface Failures

HIGHWAYS safer and more durable through improved design and construction—particularly in better soil foundations—are pictured for the future by Thomas H. MacDonald, Chief of the Bureau of Public Roads. Improvements can be attained by more use of present knowledge, he says, as research continues to arm the engineer with more information about highway materials.

Like any durable structure, the highway must be built upon a firm base. In the past, attention has been focused upon adequate drainage and hard, all-weather surfaces. The soil foundation upon which the surface is placed merits, and in the future will receive, more attention.

A test road, built by the Bureau of Public Roads and the South Carolina State Highway Department, after seven years confirms previous evidence that poor foundations, more than type of surface, are a prime cause of surface failure. The test road, 20 miles in length, was surfaced with bituminous-treated local materials. Construction methods varied on different sections of the road.

Where the foundation failed it was found that only by replacing unsatisfactory materials with stable materials or by providing better drainage could failed areas be permanently improved. Mere substitution of a new surface for the old one was but a temporary cure.

*(End of Transportation Section)*

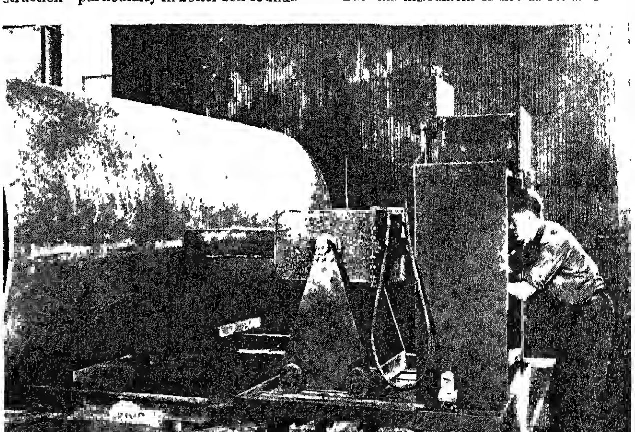
## "Lie Detector" Useful Only in Expert Hands

THE "truth about the 'lie detector'" has been disclosed by Prof. Christian A. Ruckmick of the University of Iowa, who conducted in his laboratory experiments to determine usefulness of this electric instrument often used for crime detection and for obtaining confessions from suspects.

Clever witnesses can fool the machine, Professor Ruckmick has found. But clever operators of the machine can also detect these efforts at evasion, reports *Science Service*.

In the hands of an expert who understands thoroughly the workings of the human mind and who is able, in interpreting the records of the lie detector, to make allowances for wide natural differences between the excitability of different individuals, this technique should prove valuable for crime detection, Professor Ruckmick concluded.

But this instrument is not as reliable for

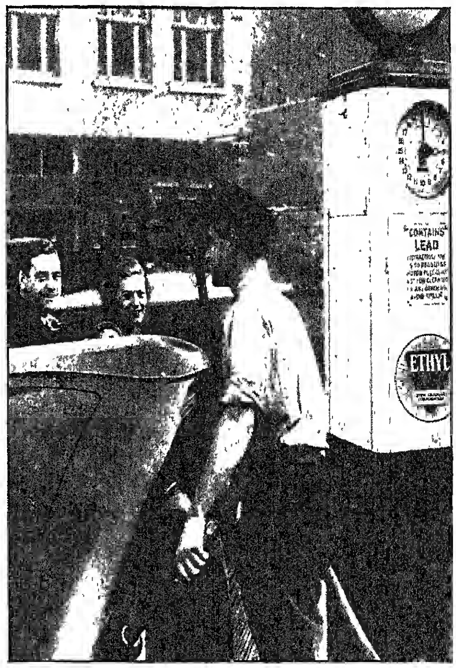


**Examining a welded seam of the barrel of the boiler described at left**

# HERE'S ALL IT TAKES *to get* *full engine power as you stop wasteful "knock"*

## Just two easy steps bring you all the economy and performance offered by modern high compression cars...

1. (*Below*) Practically all modern high compression cars have an adjustable spark for the octane (anti-knock) quality of the fuel used. "Knock" *can* be eliminated by retarding the spark, but the result is loss of power, sluggishness, danger of overheating and waste of gas and oil. To take full advantage of your high compression engine, have your car dealer adjust the spark for *maximum* performance. It takes only a minute or two, and then...




2. (*Above*) Use Ethyl! Your high compression engine, with its spark properly adjusted for maximum performance and with Ethyl in the tank, will give you the fast acceleration and the generous reserve of power it was meant to give. Ethyl is at least six octane numbers higher in anti-knock value than any regular-grade gasoline—and what a difference that extra anti-knock value makes in the engines of modern high compression cars!

## Here's the EXTRA value you get at the ETHYL pump:

1. You get more anti-knock fluid (containing lead tetraethyl) at pumps marked "Ethyl" than you get in the best regular-grade gasoline.
2. You get the all-round quality (including quick starting) that is *double-tested* by the oil company and by the Ethyl Gasoline Corporation.
3. You get 100% performance from your high compression engine.
4. You save on oil as well as gas by preventing overheating.

ETHYL
ETHYL GASOLINE CORPORATION

**NEXT TIME GET ETHYL . . . A BETTER RUN FOR YOUR MONEY**

purposes of identification as either facial photography or fingerprinting, he warned, and therefore becomes a dangerous weapon in the hands of any but the most competent persons.

"The situation is in the same category as are many other techniques including mental testing," Professor Ruckmick said. "Only those who can see beyond the actual scores and interpret these scores in the frame of the individual mental life are competent to pass judgment."

## A New Use for Heavy Water

IN speculating about the future, Professor James Kendall of the University of Edinburgh, Scotland, suggested in a recent interview that old age may be made much more comfortable in the future by slowing down a person's chemical reactions by generous use of heavy water. As a speculative possibility this has a sound scientific basis whether it will ever be realized or not. By substituting hydrogen having an atomic weight of 2 for the customary kind, whose atomic weight is only 1, in the fluids of the body, it should be possible to reduce materially the rate of chemical reactions which characterize life. In other words, as a person approaches the period of inactivity of old age his metabolism can be made slower to meet his requirements and thus avoid too rapid body functioning. *D. H. K.*

## Warn Children Against Playing with "Dry Ice"

DON'T let children get hold of dry ice, warn Drs. Max L. Som and A. Harry Neffson of New York City. One of the popular neighborhood diversions is to beg or buy some carbon dioxide snow and to put a small piece of it in the mouth. Then the child will blow off "steam."

These two physicians report the case of a seven-year-old boy who swallowed a piece of dry ice, in the *Journal of the American Medical Association*. The boy is all right today, but it took a great deal of medical treatment and surgery before the damage was repaired.—*Science Service.*

## Plant Preferences in Wavelengths

GROWTH of plants, upon which all life ultimately depends, requires the absorption and assimilation of carbon dioxide from the air under the influence of light. This is the basic physio-chemical reaction of all life. The assimilation of carbon dioxide takes place throughout the entire range of visible light from the deep red to the violet, but like the eye, a plant is more sensitive to some colors than others.

By use of the Christiansen filter, an instrument which makes possible plant illumination with color bands between very narrow limits of wavelengths, Mr. W. H. Hoover of the Smithsonian Institution has studied the effects on photo-synthesis of the constituent wavelengths of the entire visible spectrum. He finds that there are two points where the effect of illumination is greatest. One is in the deep red, centering around the spectrum line of hydrogen at a wavelength of about 6550 Angstrom units, and the other

of 4400 Angstrom units. An Angstrom unit is a ten-millionth of a millimeter and is the unit most convenient to use in measuring the wavelength of light.

Green light, Mr. Hoover found, is rather poor in its efficiency as an agent of photo-synthesis. This was to have been expected, since the carbon-dioxide assimilation requires the absorption of the light by the molecules of the green coloring matter of the leaves, chlorophyll. A large percentage of the green light is reflected by the green leaves, which is why they appear green to the eye. Little of it is absorbed.

Mr. Hoover found that the photo-synthesis effect begins at the very limit of the visible red, just as it verges into the invisible infra-red. On the other end of the spectrum, however, a slight effect is found just over the limits of the ultra-violet, which is invisible to the human eye.

As a result of the experiments, the 6550 and the 4400 Angstrom-unit lines of light appear to be the dominating factors in the basic phenomenon of life.

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**POWER**

STEAM power plants in the United States burn about the same amount of coal now that they burned in 1920 but they generate twice as much electricity with it. The use of high-temperature steam with a resulting higher operating temperature for the turbine is partially responsible. A modern turbine shell runs, almost literally, red hot.

## No More Sheep's Wails* As Off Come Tails

SHEEPMEN in the Uvalde section of Texas are using rubber bands instead of surgery to bob lambs' tails, according to information received by The B. F. Goodrich Company.

The newest method of tail bobbing involves only the tight application of a rubber band in the right location to stop circulation. After a time the tail drops off, saving expense, time, and trouble for ranchmen, and some pain and possible infection for the lambs.

*A sheep or lamb bleats, as we know, but the word doesn't rhyme.

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## Flavors of Meat and Meat Products

MEATS are among the foods most desired by savage and civilized man alike. Meats possess not only proteins and minerals of high nutritive value but also flavor, that highly desirable adjunct in food. This problem of flavor is now being studied systematically.

The Bureau of Animal Industry has been engaged for several years in studies leading toward the production of superior animals the meat of which will possess the characteristics desired by critical consumers. Until recently the flavor of cooked meats resulting from these controlled experiments has been determined solely by trained judges who evaluate, by taste and smell, the results for intensity and desirability of flavor. A

# THE AMATEUR TELESCOPE MAKER

**Conducted by ALBERT G. INGALLS**

IF you make your own eyepieces, or plan to learn this branch of the telescope making hobby now that R. E. Clark has explained the work in such minute detail in the new book "Amateur Telescope Making—Advanced," the four small photographs in Figure 1 may interest you. The photographs and the eyepieces were both made by D. Everett Taylor of Willimantic, Connecti-

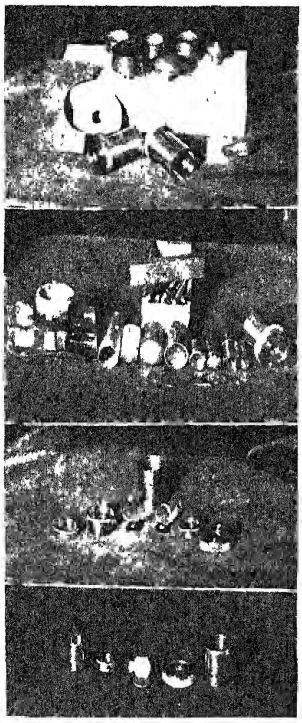


*Figure 1:* Eyepieces

cut, author of the chapter on refractor mountings in that book, and they exhibit the neatness that is characteristic of his work.

Top photo (*Eeny*): "Templets and tools used in making the lenses for the two eyepieces shown," Taylor states. "Templets were machined to .001", curves on tools are equally accurate. The field lens is of Chance Bros. crown and the smaller lens is a cemented doublet of barium crown and flint. First class performance from both eyepieces."

*Meeny:* "From left to right: A block of glass from which two cylinders have been ground; the trepan that did the grinding; a cylinder of glass ¾" in diam. x 1⅜₂" long, ground out in one hour without forcing; six brass tools for grinding curves, and the finished Hastings type D eyepiece. In the foreground are the precise templets with which to check curves. The background shows a group of drill-rod tools with holder, used for fine thread cutting and work on small parts."

*Miny:* "A 1½" eyepiece completely disassembled. The 'skirt' or tube is steel (less likely to scratch from brass adapter tube). The four cell parts are of tobin bronze. Smaller lens is a cemented doublet of barium crown and flint."

*Mo:* "A ¾", type D Hastings eyepiece completely disassembled. The first two parts are the cell which holds the lens. Next is the complete lens, showing the tiny cap lens which is cemented to the small end of the cylinder. Then comes the front or eye end made of tobin bronze, and at right the skirt of steel. All parts are precisely centered."

Figure 2, also by Taylor, shows his drill-press setup for grinding cylinders from a block of glass. "Note the dam of wax which forms a well to hold the abrasive mixture," he writes. "This arrangement keeps the trepan from overheating, reduces the necessary grinding time to one third, is economical on abrasive and makes a cleanly performance, as can be seen from the photograph. This was taken immediately after releasing the cylinder, and with no cleaning up except to wash the cylinder. The latter shows in the foreground, washed free of the grinding goo. Tools for grinding the curves of a Hastings D type lens are shown lined up, in order to include them in the photograph."

IN one chapter of "A.T.M.A." Dall of England describes the construction of a camera obscura, consisting of a movable flat projecting above the roof of a house and feeding downward into an objective lens which throws its image vertically down on a viewing table in an attic. Figure 3 is a terrestrial photograph made through this instrument. "I was trying," Dall writes, "to take an infra-red photo of a little church which stands up in the sky-line 17 miles from here, in Buckinghamshire. I have got best results so far with visible light and a red filter instead, because of the too lengthy exposure with infra-red, also because of enhanced diffraction effect of the longer wave. Infra-red long-distance photography tends to defeat itself, as far as detail is concerned, because of the reduced resolving power of the long wavelength. A 2" telescope will give as good an image at 5000 A.U. (average of spectrum) as a 4" telescope at 10,000 A.U. (infra-red), although the infra-red does penetrate atmospheric haze. Objective diameter 4¼", plus eyepiece, plus enlargement. Red screen and Ilford Panchro plate. Exposure 2 minutes (This house won't 'stay put' for a long exposure. A temperature difference of a degree or so will cock the house over enough to give a band image of a line at this high magnification.) at 8 P.M., last July. Beclouded sun immediately above and slightly to right. *E.f.l.* of final result about 1400", or 115'. The curve drawn on the photo shows the size of the setting sun or moon at the same scale. The little drainage trough just visible [It shows on the original but not on the half-tone, hence we added an arrow.—*Ed.*] sticking out of the distant tower would be about 6 inches across. It is a coincidence that my viewpoint shows two churches, one distant 17 miles, the other 5½ miles, within 1 minute of arc of one another."

Foreground objects in Dall's photograph, under-exposed as he explains, are rather dim and the half-tone reproduction renders them still more so. On the original the details of the foreground, consisting of treetops, are visible, and the picture has considerably more life than in the half-tone.

Any readers of "A.T.M.A." who may be planning camera obscuras will gladly be hooked together by ye scribe if they care to send in their names—a sort of "Camera Obscura Club" would thus be formed. It is also expected that the publication of Haviland's detailed instructions for making objective lenses by something more like professional methods than any instructions previously available, will result in a trend in that direction, as "A.T.M.A." has already reached more than 1200 persons, assuming but one reader to a copy—quite an assumption, for some copies are known to be read by a dozen amateurs.

THOSE of us who observe in the East, or even in parts of the West, will envy Clyde W. Tombaugh ("A.T.M.A.", page 639) of the Lowell Observatory in Arizona, where seeing is really seeing. He writes:

"I have been having some fine views of Venus, Mars, and so on, through my 12". On the 5th of March, during the early twilight of the evening, the seeing was ripping good—No. 8 on a scale of 10 (10 giving a perfect diffraction pattern for a 5" object glass) and I finally put on a power of 742. The image of Venus was huge, perfectly sharp, clear cut, and there was scarcely a quiver.

"On the morning of March 11, I had some No. 6-7 seeing with my 12", power 300, and saw the minute northern polar cap (now at

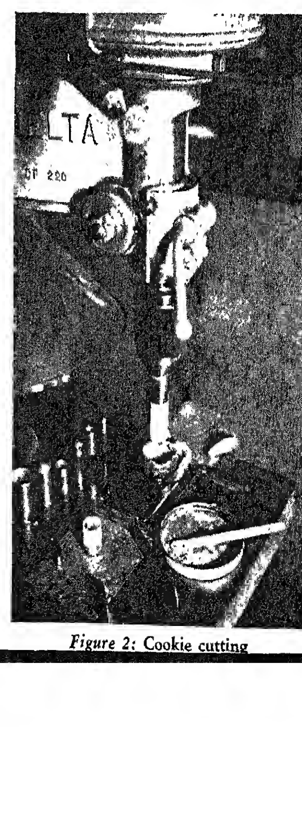


*Figure 2:* Cookie cutting

minimum size) of Mars well; it was only about ½ by ¼ second of arc, down at the N. limb of the planet. I saw the oasis Isminii Luci, cloud areas, Dawes Forked Bay, Syrtis major, portions of the Protonilus and Deuteronilus "canals", and glimpsed the Hiddekel and Gehon "canals"! The colors of the markings came out beautifully in the morning twilight. At that time, the angle subtended by the disk of Mars was only

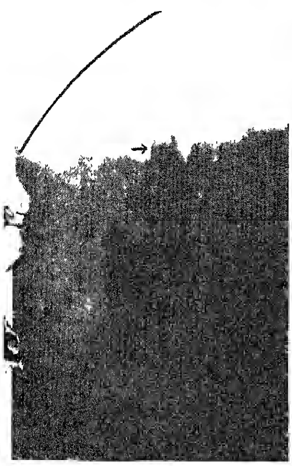


*Figure 3:* Camera obscura photo

9.8 seconds of arc (equal to that of a 3" ball placed a mile away). Isn't that enough to thrill anybody? At moments of very good seeing, the whole disk of the planet came out very hard and sharp (then is when one sees the canals).

"The time to really see things on planets is during the twilight, both morning and evening, when there is a lull. We find that our seeing in regard to steadiness is generally 2 to 3 points lower during the middle part of the night. Soon after the sun gets up in the morning the seeing begins to dance again. Most people think they should wait until it is good and dark before looking."

THERE is evidently much interest in the Richest-field Telescope described in the final chapter of "A.T.M.A." The only misprints yet found in this book which could really cause trouble are in that chapter. On page 635, bottom paragraph running over to next page, please change the capital letters $M$ in five places to $m$. On page 637 line 2, make log delta sub $m$ read simply log delta, and in line 3, make delta $m/a$ read delta over $a$ squared. Of less importance, on page 140, line 2, change "opposite" to "preceding." On page 155, third line, change plano-convex to plano-concave. Page 215, Figure 1 was accidentally turned on end. Page 334, shift footnote star in line 5 to page 335, line 34, after "14". Page 348, line 11, change "remaining" to "ramming." Page 583, line 18, insert after "image," "as full as the eye can accept." Please report any other errors found.

AMATEURS who collect practical data on telescoptics (how do you like that word?) may wish to obtain a pamphlet entitled Abrasive Grain Sizes. Write Supt. of Documents, Washington, D. C., and ask for R118-36.

AUTOMATIC guiding again: In August, 1934, James T. Berkeley, of Los An-

geles, described his attempts to solve this intriguing problem and last January Wilbur Silvertooth of Long Beach, California, described the efforts he too has made. Further efforts toward solution of the same problem are now outlined in the March number (Vol. 8, p. 78) of the *Review of Scientific Instruments* (Lancaster, Pa.) by A. E. Whitford

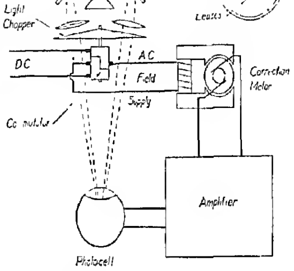



*Figure 4:* **Automatic guider**

and G. E. Kron, of Washburn Observatory, University of Wisconsin, Madison, Wis. The following is from their article:

"The principal difficulty in designing an automatic guider for a telescope is the extremely small amount of light available to actuate the mechanism. Most photo-electric control devices operate on $10^{-2}$ to $10^{-3}$ lumens, but an automatic telescope guider must work on $10^{-9}$ to $10^{-10}$ lumens to be successful.

"The plan of operation of the automatic guider in its present form is shown schematically in Figure 4. The control is exercised in one coordinate only. The similarity with the original design of the Hardy color analyzer is evident. A 90° roof-prism aluminized on its upper surfaces is set in the focal plane of the telescope and divides the light of the star into two parts. These two beams are reflected by mirrors, pass through converging lenses and are reunited on the sensitive surface of a photo-electric cell. A light-chopper nearly in the plane of the lenses occults the two beams alternately. If the star image is not centered exactly on the knife-edge, unequal amounts of light will pass through the two lenses and there will be an alternating intensity on the photo-cell. The alternating voltage thus generated is amplified many times and applied to the armature of the correction motor. The field of the motor is supplied with current of the same frequency from a commutator on the same shaft with the light-chopper. The correction motor drives the telescope or a sliding plate-holder in the focal plane in such a direction as to correct the error. When the star image is centered exactly on the knife-edge the two beams are equal, there is no flicker and the motor stops. When the star image moves from one side of the knife-edge to the other there is a change of 180° in the phase of the armature current with respect to the field current and the motor reverses its direction of rotation.

"The advantages of this system of control are: (1) Because there is only one photo-cell and because a.c. amplification is used, the balance condition is dependent on geometrical considerations only, and is independent of drifts in steady-state currents in vacuum tubes and changes in cell sensitivity. (2) The control is exercised entirely by

lays. (3) As long as the error is less than half the diameter of the star image (and an error larger than this is certainly beyond the limit of tolerance) the correcting impulse is proportional to the need for it. As the balance point is approached, the motor current gradually goes to zero. This permits rapid correction of an error without the oscillation about the mean position common with simple on-and-off methods of control.

"This arrangement was tried out on the 10" photographic telescope of the Mount Wilson Observatory, and later at the Cassegrain focus of the 60" reflector." The results are shown in three star photographs not here reproduced but the authors describe them as follows: "In all three cases the guider corrected a cumulative error in right ascension and produced round star images of about the same diameter as 1-second exposures of bright stars.

"In the preliminary tests of the guider's usefulness made thus far it has been considered sufficient to confine the control to one coordinate. In order to have control in both coordinates, the outfit would have to be duplicated. Two knife-edge prisms set at right angles could be used, with separate guiding stars for each, or the light of a single star could be divided by a half silvered mirror. Perhaps the best system would be to use a four-sided reflecting prism."

The four-sided prism method was the one proposed by the amateur, Barkelew. Just how far this latest bit of work, following the work previously described by amateurs, has gone in the direction of a final solution, cannot yet be said, but the results appear to be promising.

IN April, 1936, we showed how W. B. Hiner, 123 Cleaves Ave., San Jose, Calif., attached a simple "Barlow" lens fixedly to the end of an eyepiece. Figure 5 shows a later arrangement of his which has variable magnification. As the largest lens is moved toward the diagonal the eyepiece must be moved away from it, as provided by his mechanism. Such a lens is, of course, not achromatic and with higher powers it gives pronounced color on the planets, but this is less noticeable on the moon, he states.

Answering several inquiries about achromatic Barlows, J. R. Haviland, author of the chapter on objective lens design in "A.T.M.A.," says: "Use same formula as for achromatic O. G. Start with focus, say, minus 8- or 10", take account of signs in formula, and results will give foci of two components.

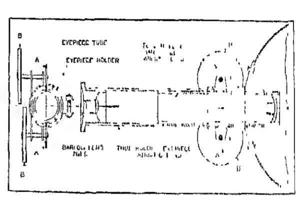


*Figure 5:* **Hiner's arrangement**

Go on from there same as for positive lens. When used as a Barlow flint is first, that is, away from the eye and toward the sky."

FIGURE 6 shows what James W. Lillico, 10 Bayley Ave., Yonkers, N. Y., thinks a perfectly good bathtub is for. "Living in an apartment and having a wife," he writes, "I could not see the possibility of having

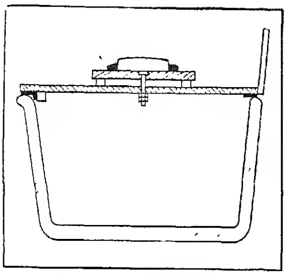


*Figure 6:* TN housekeeping

en." Years ago, when R. W. Porter took up mirror making, that is what he did and Mrs. Porter says he tracked a heavy, red ring of rouge around a pedestal on her kitchen floor. Once his rouge was accidentally mistaken for paprika and shaken on baked potatoes.

AND now comes a note from Russell W. Porter, whom we have frequently begged to send us, for this department, any homely little scraps of information or practical sidelights on the progress of the 200" at Pasadena until it is finished. "In order to show members of our fraternity the care exercised in safeguarding the 200" mirror from scratches, I am sending you a sketch (Figure 7) taken at the wicket door where all who enter the large room are required to remove their shoes and to don rubber sneakers. Before this rule was laid down, sweepings from the optical shop floor showed innumerable pieces of steel chips that had found their way into the 'holy of holies,' clinging to the soles of shoes of workmen—or visitors—who thus unconsciously imperiled the surface of the big disk.

"As the 200" telescope is the No. 1 exhibit here on the campus now, the visitor's gallery is well patronized by tourists from all over the states."

The sign on the doors reads: "No Admittance. Please do not open these doors until the outside doors are closed."

WHAT TN can read Czech? Each month the Czechoslovak Astronomical Society sends us a neat little journal named *Rise Hvczd*, but we can't read it. One page is evidently devoted to amateur telescoptics, some of which may call for translation and presentation here, but it's all Czech to us.

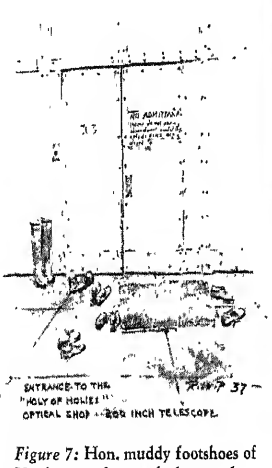
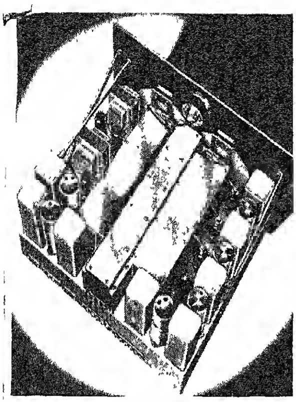



*Figure 7:* Hon. muddy footshoes of Yankee tourists parked near door



Chassis view of the new Super-Pro receiver described in these columns

identical, and are equipped with electrical band-spread in the short-wave bands, a continuous band-width control which permits high-fidelity reception from local broadcast stations, calibrated sensitivity, audio and beat oscillator panel controls, and a tuning meter.

Means are provided for the reception of c.w. code signals, and a toggle switch on the front panel permits the operator to switch from loudspeaker to headphones which are permanently connected. The powerful audio amplifier and loudspeaker may be used in conjunction with a turntable and pick-up for phonograph reproduction by merely connecting the pick-up leads to a small terminal strip located at the rear of the receiver.

The Super-Pro has a high degree of stability, sensitivity, and tonal fidelity. The dial calibrations are held within a tolerance of plus or minus 0.5 percent, which assists immeasurably in rapidly locating stations of known frequency.

## New Daventry Frequency

A NEW frequency—GST on 21.55 megacycles or 13.92 meters—has been allocated for use by the BBC for its Empire transmitters at Daventry. Although it is not proposed to operate on that frequency immediately, it may be used from time to time during the summer months.

The identification-word of the call GST will be "Transmitter." As listeners to Daventry are aware, the letters "GS" are common to all sixteen calls associated with the BBC's Empire Service, the final letters of the calls being the differentiating factor. To avoid confusion in the announcements of the calls, an identification-word has been allotted to each final letter. The identifications in present use are:

| | |
|---|---|
| A for Aerial | H for Home |
| B for Broadcasting | I for Ireland |
| C for Corporation | J for Justice |
| D for Daventry | K for King |
| E for Empire | L for Liberty |
| F for Fortune | O for Ocean |
| G for Greeting | P for Progress |

## Naval Radio Time Signals

TIME signals are transmitted daily on a number of frequencies and at various

at Arlington, Virginia, and NSS, at Annapolis, Maryland. During the time broadcasts these stations operate in synchronism.

The signals commence five minutes before the hour and end exactly on the hour. Most of the transmissions are broadcast simultaneously on two or more frequencies, as indicated in the following schedule:

| *Time(E.S.T.*)* | *Frequencies in Kilocycles* |
|---|---|
| 0055-0100 | 113, 9425 |
| 0155-0200 | 113, 9425 |
| 0255-0300 | 113, 9425 |
| 0355-0400 | 113, 9425 |
| 0455-0500 | 113 |
| 0555-0600 | 113 |
| 0655-0700 | 113 |
| 0755-0800 | 113, 9425 |
| 0955-1000 | 64, 113, 4390, 9250, 12630 |
| 1155-1200 | 113, 9425 |
| 1255-1300 | 113 |
| 1355-1400 | 113, 9425 |
| 1455-1500 | 113 |
| 1555-1600 | 113, 9425 |
| 1655-1700 | 113 |
| 1755-1800 | 113, 9425 |
| 1855-1900 | 113, 9425 |
| 1955-2000 | 113 |
| 2155-2200 | 64, 113, 4390, 9250 |
| 2355-2400 | 113, 9425 |

A frequency of 64 kilocycles is equivalent to a wavelength of approximately 5000 meters, and a frequency of 113 kilocycles is approximately 2500 meters. These are not covered by the average all-wave receiver and therefore cannot be intercepted unless a special receiver covering these frequencies is employed. However, at least one high frequency which is within the range of the average all-wave set is used at most hours.

*The times given are based on the 24-hour day system used by the Navy. Thus, 0100 EST may be read as 1 AM, EST, and 1200 as noon. —*Ed.*

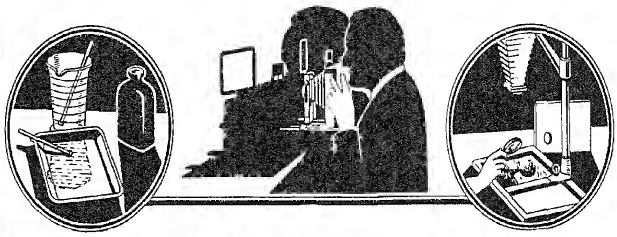
## New Short-Wave Broadcasters

WITH the arrival of the warm months, when reception in the short-wave bands is often less subject to atmospheric disturbances than it is in the standard broadcast band, a number of new stations have added their voices to the many others in the already over-crowded high-frequency spectrum.

But when there is no station interference to mar reception, listeners will find the programs from the foreign broadcasters distinctly refreshing. To those whose hobby it is to collect verification cards, the new stations will be welcome additions to those already logged.

The latest stations, with their frequencies, calls, and locations, are given in the following list:

| *K.C.* | *Call* | *Location* |
|---|---|---|
| 18090 | FYE-1 | Paris, France |
| 17775 | PHI | Huizen, Holland |
| 15160 | OLR5C | Prague, Czech. |
| 11900 | OLR4D | Prague, Czech. |
| 11895 | HP5I | Aquadulce, Panama |
| 11820 | XEBR | Hermosillo, Mex. |
| 11040 | CSW | Lisbon, Portugal |
| 10670 | HBP | Panama City, Pan. |
| 9550 | OLR3A | Prague, Czech. |
| 9504 | OLR3B | Prague, Czech. |
| 9340 | OAX41 | Lima, Peru |
| 9120 | CP-6 | La Paz, Bolivia |
| 6210 | YV1R1 | Coro, Venezuela |
| 6130 | LKJ1 | Jeloy, Norway |

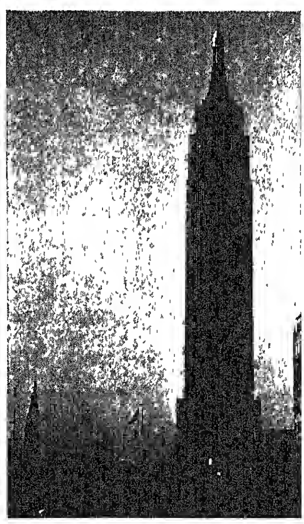


# CAMERA ANGLES

**Conducted by JACOB DESCHIN**

## Mood and Aspect

FROM the time you arise in the morning until dusk and the night, you will notice, if you are observant (which you are, if you have the make-up of the serious amateur), that there is a constant change in the appearance and the atmosphere surrounding familiar scenes and objects. Scientifically the changes are due to variations in lighting, but actually the differences are due also to matters of an emotional nature. In the morning you feel refreshed and eager, full of plans for the day; in the afternoon



"Dawn"

there is a considerable letdown; by dusk you are ready to call it a day and long for the easy chair, the pipe, and the book.

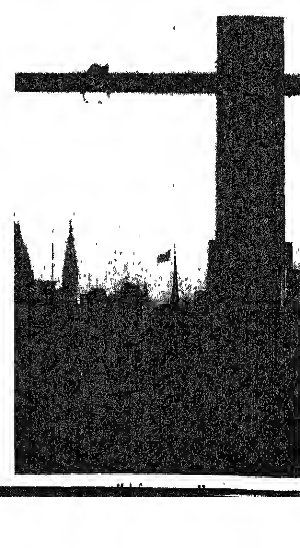
We have tried to express something of the sort in the three pictures illustrating this piece. "Dawn" shows the lyrical touch of the rising sun on the side of the building and the gradual illumination of the sky; "Afternoon," as seen through an office window, suggests the work-a-day world, with its view of the buildings in which many like yourself are bound to their duties; "Dusk" interprets the sombre aspect of the day's end, with its silhouetted skyline and masses of slowly moving clouds.

Whether you live in town or country, city or hamlet, this continual process of transformation is made apparent to you in many ways. Doubtless you have made pictures on various occasions when certain familiar scenes presented their most attractive aspect. However, to photograph a single scene at different times of the day, accu-

dozen pictures giving a story in sequence of the varying effects created by the "painter's brush" of the sun, will provide you with a group of photographs which, if well done, should give you much real satisfaction and pleasure.

We referred some months ago to the plan of photographing a scene as it appears at different times of the year. We would like now to recommend the making of a series of pictures of a single scene as it appears during a typical day in early spring, in summer, in the fall, and in winter. Only distinct changes, of course, should be recorded, and the scene chosen should be attractive enough and lend itself sufficiently to the idea to make such a series worth the effort that will have to be put into it. Choose a scene you know well and have observed often and admiringly. You could easily fill a special album of modest dimensions with a season-to-season, mood-to-mood record of such a subject.

The taking of the picture, that is, the making of the exposure, is just the beginning, and if you go ahead and simply make ordinary prints or enlargements on the same paper for all the scenes, you will be missing the whole point. Some of the scenes will be more suitably printed on glossy paper, others on semi-matt or matt. You may wish to treat some to a toning bath while others, like a snow scene, you will find more attractive if done in pure black and white. If you take to the album idea, you will find it preferable to make the prints or enlargements all of the same size; 4 by 5 or 5 by 7 inches should be ample. It is doubtful if such a series, even if only three or four are made, would look well in a frame on the wall, but there doubt-



"Dusk"

less will be at least one or two that you will want to hang separately. One idea would be to hang a favorite picture of the scene during the season in which it was taken, the spring scene in the spring, the snow scene in the winter, and so on.

It sounds like an awful lot of trouble, we know, but if the opportunities are available and you feel so inclined, we are sure you will find it worth your while.

## Luminous Paint

If you have been having trouble seeing things in the dark, especially when developing panchromatic film under the weak light of a green safelight, perhaps the use of Ray-O-Lite will help. This is a luminous radium paint for painting watch dials, second hands, light meters, and other darkroom apparatus. It is available in six colors, and is said to be easy to apply, absolutely harmless, and lasting. It comes ready for use in ¼-ounce and 1-ounce bottles.

## Photography First

According to the annual poll of the graduating class of the Columbia University Engineering School by the *Engineer*, school annual, the average senior of the class is an amateur photographer, any other hobbies or outside interests he may possess taking second place.

## Mercury Vapor Photographic Lamp

Mercury vapor, long the ally of photographers, is again being utilized in a new photographic lamp now under development in the Mazda Lamp Laboratories, according to an announcement by the Lamp Division of the Westinghouse Electric & Manufacturing Company.

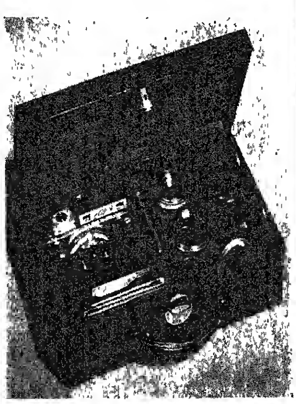
This new light source, which will later be known commercially as the Flood-Flash lamp, is similar in appearance to some of the high intensity mercury vapor lamps now on the market in that it consists of a bulb within a bulb. It has an overall length of approximately six inches and a diameter of approximately 1½ inches. Under continuous operating conditions, the lamp consumes about 100 watts, producing 3000 lumens. However, by operating it in conjunction with special equipment, high momentary current discharges may be passed through it, resulting in a flash at peak brilliancy of about 500,000 lumens with an average brilliancy of 300,000 lumens.

The flash may be so controlled as to be timed with the opening of a camera shutter, thus making possible the utilization of a light of high intensity and great actinic value at the instant the photograph is taken.

At the present time, the Flood-Flash lamp is not available commercially since further development on it is necessary. When perfected, this lamp may be used for general lighting of a studio while posing the subject and focusing the camera and then may be flashed for the actual photograph. The same lamp may be flashed as often as necessary.

## Plaubel Makina II S

Ever alert to new trends in photographic practice and the needs of the times, the Plaubel Makina, for many years the choice of the pictorialist and journalistic photographer seeking in a single outfit an instrument readily adaptable to any need that may come up, now offers new advantages. In its altered aspect, the Makina is now the Makina II S, in which is introduced as its principal feature a new type of lens mounting. It is neither a screw-in mount nor a bayonet mount, but something altogether original—a half-screw arrangement which combines the advantages of both methods. The quick interchangeability of lens units that is now so greatly desired by workers who often have to use lenses of different focal lengths on a single occasion when speed of adjustment is a prime factor, is thus accomplished in the Makina II S without the sacrifice of any of the advantages embodied in the other model. Indeed, there are now two Makina models, differing from each other in this single respect. To the man who has no need for speedy interchangeability of lenses and finds all his needs cared for in the standard outfit, which accommodates the 4-inch Anticomar F:2.9 objective, the regular Makina may seem preferable since the design of the mount on the Makina II S has made it necessary to extend the lens one inch beyond the plane of the lens board. It is, then, simply a matter of choice dictated by



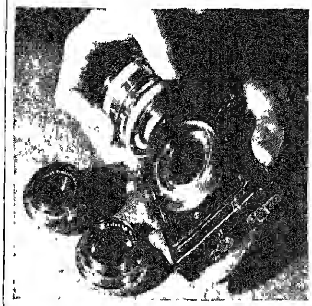
The complete Makina II S outfit

presence of an attending engineer

Claims made for this process are that it

the requirements of one's method of working as well as one's desires and needs.

Another new feature incorporated in the Makina II S (the S standing for Speed Change in lens units) is the design of the mount of the seven filters, ample to serve every task one may undertake. These seven



*Makina II S lenses have the advantage of a "half screw" arrangement*

filters fit any one of the three lenses which constitute the complete Makina II S outfit —the 4-inch Anticomar F:2.9, the 7⅝-inch Tele-Makinar F:4.8, and the 2⅞-inch Wide Angle Orthar F:6.8—by screwing over the first two lens mounts and inside the wide angle lens. The filter outfit, which consists of three yellow, a red, a blue, a green, and an ultra-violet filter, thus assumes a universal aspect.

As always, the new Makina is also universal as to the type of sensitive material that it can accommodate, being the only camera on the market with a back that will take instantly a roll-film holder, plate and cut film holders, or a filmpack adapter. All of these units are also a part of the complete outfit.

## Spiral Film Wallet

An inexpensive negative file consisting of a spiral-bound book of ruled pages and transparent envelopes is announced by Willoughby's, under the name Spiral Film Wallet. Costing less than the price of a movie ticket, the file takes strips of negatives up to the size of the 120 roll film. The great convenience of being able to view negatives without the necessity of removing them from their envelopes is obvious and because the binding is of the popular spiral design, each data sheet and envelope lies flat.

## Candid Camera Nights

Special nights set aside in theaters, radio stations, and other places of entertainment when candid camera shooters are invited to come and take all the pictures they want have become very popular. Just what happens on these occasions may be discerned from the *Chicago Tribune* description by Frank Marshall Moore of one such event, regularly held in the College Inn of the Hotel Sherman in Chicago.

"Picture, if you can," he writes, "more than three-score snapshooters, perched on table-tops and pianos, others in kneeling position, and still others prone on their backs, taking a bead on the fleeting Gertrude Hoffman Girls—from every conceivable angle. Heads and shoulders pop up suddenly from nowhere, and as quickly recede. More daring hawks swoop down in

the very midst of the entertainers, shoot and retreat. Some shoot other shooters shooting. The band blares on. The drums beat out a steady machine-gun barrage. Some take cover, exhausted from their mad race about the battle field. Others fall back to recuperate from an attack of laughter that leaves them limp and quaking. It's gay, it's fast, it's sheer idiocy. But it's fun."

Mr. Moore is reminded of Tennyson's "Charge of the Light Brigade."

## NEW CONTAX LENS

THE recent addition of a new lens to the already long and varied list of objectives available for the Contax now brings the total up to 14, offering a lens choice ranging from a focal length of 28 mm up to 500 mm and of angles of view from 75 to 4.5 degrees. The new lens—the Zeiss Biogon F:2.8 35-mm wide-angle lens—has the three features which many serious amateurs have long sought, namely, a wide angle having a great depth of field yet possessing speed. The lens covers an angle of view of 64 degrees, as compared with the 55-degree angle of the 40-mm Biotar F:2 and the 75-degree angle of the 28-mm Tessar F:8 extreme wide-angle lens. The standard 50-mm lens, as is well known, covers an angle of 45 degrees.

## UTILITY CUTTER

A METAL frame conveniently fitted to a comfortable hand grip and instantly adjustable for holding cutter blades in various positions is on the market as the Brooks Utility Cutter. The heavy-weight blades furnished for the cutter slide into the handle when not being used, thus preventing possible accident from having a sharp instrument lying about. The cutter is designed specially for cutting cardboard of various weights, being equally useful for cutting heavy wallboard and light veneer wood. The handle is polished aluminum with a wing locknut.

## SPOTLIGHT SILHOUETTE

THIS month we introduce what we dare to call a new type of silhouette, though for all we know it may already be familiar to

some of our readers. Possibly it is more useful in commercial photography, particularly in making pictures for a hair-dressing establishment, but we can see where it might be appropriate in the amateur world where it is desired to get special effects in portraiture. The lighting used in the accompanying illustration is, of course, obvious. A single spotlight was so directed from above that it lighted up the hair of the sitter as well as the tip of her nose and a patch on her temple, while the rest of the subject's face is outlined in silhouette against the circle of light on the background. There are several variations of this method which may be tried by those interested, the only requirement being that a single light, preferably a spotlight, be used for illumination.

## Champlin No. 15 Formula

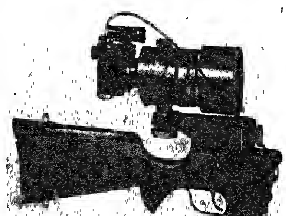
COINCIDENT with the publication of Harry Champlin's new book "Champlin on Fine Grain" is the announcement of the author's new formula for developing fine-grain film—Champlin No. 15. It is obtainable ready mixed in 24-ounce bottles, but for those who would like to know what's in it, the ingredients are as follows:

| | |
|---|---|
| Water | 20 ounces |
| Rubinol or Pyro | 32 grains |
| Sodium Sulfite | 1½ ounces |
| Acid Benzoic | 12 grains |
| Acid Salicylic | 4 grains |
| Acid Boric | 25 grains |
| Acid Digallic (Tannic) | 9 grains |
| Glycin | ¼ ounce |
| Paraphenylenediamine | ¼ ounce |
| Alcohol Iso Propyl 97 percent | 1 ounce |
| Nickel and Ammonium Sulfate | 10 grains |

The chemicals should be dissolved in the order indicated, the paraphenylenediamine being dissolved separately in a small quantity of water heated to about 180 degrees, Fahrenheit, and then added to the developer, Mr. Champlin states. "After the solution has been cooled to 70 degrees, Fahrenheit," he continues, "dissolve the nickel and ammonium sulfate in a small quantity of water (1 ounce) and add very slowly to the developer."

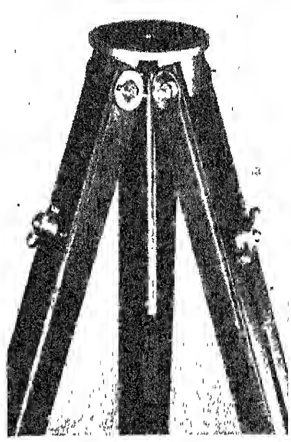
## Olympic Gun For Long Shots

SOMETIME ago we announced in this department a new telephoto lens for the Contax camera, combining speed and real distance-snatching. It was the Sonnar F:2.8 of 180-mm. (7-inch) focal length. We mention it again not only because we wanted an excuse to publish this striking picture, but also to call attention to the unique "tripod" now being furnished for it. The outfit is called the "Olympic Gun" because it was widely used by press and sports photographers in covering the Olympic games in Berlin. This is what we call literally shooting pictures!



## Two-Section Wood Tripod

FLEXIBILITY, light weight, attractive appearance, and moderate price are combined in a new tripod called the Bee Bee Wood Tripod. Despite its light weight, this tripod is rigid, rugged, and durable, and is made of a hard, close-grained wood.



Top of a new tripod

It has two sections for convenience in carrying and is equipped with substantial locking devices on top and bottom, being also provided with a conveniently located and easily manipulated handle for locking the camera onto the tripod head.

The Bee Bee Wood Tripod is sufficiently strong to bear the weight of fairly heavy view cameras. When closed its height is 2 feet, 7 inches, and when fully extended, 4 feet, 7 inches. The diameter of the head is 3¼ inches, the screw handle is 8¼ inches long, and the tripod's weight, 3 pounds, 14 ounces.

## Companion Reflex

REFLECTING the increasing popularity of the twin-lens type of miniature reflex camera, a new relatively low-priced outfit called the Companion, of Czechoslovakian manufacture, has just been imported for distribution in the United States. Both lenses are the same, the Meyer Trioplan F:2.9, and the film size is 6 by 6 cm (2¼ inches square). This is considered a rather fast lens speed for this type of camera. The shutter is of the Compur type with speeds up to 1/250th second and roll film is used. Automatic film transport, pressure plate back for holding the film perfectly flat, depth of focus scale, and attractive chromium appearance, constitute some of the features of the Companion.

## "Popular Photography"

THE first issue of the new photographic magazine being published by Ziff-Davis Publishing Company, of Chicago, which was announced in this department some months back, was published in April under the name, "Popular Photography."

copies and a cover in full color, the magazine contained articles of varied photographic interest, both in the fields of still and motion picture photography. It is replete with helpful articles, many illustrations, and enthusiastic announcements for the future. We wish for it all the good luck in the world.

## Perspective

THE camera being a one-eyed creature, we resort to every device available to give a three-dimensional, stereoscopic appearance to the subject photographed, in order that the resulting print may be a fair representation of the original. In stereo-

"Progress"

photography this is accomplished by two pictures, the two combined, as viewed through a stereo viewer, permitting the same binocular vision as that enjoyed in viewing the subject itself. Two devices by which we attempt to gain perspective—that is, depth—are illustrated in "Progress." One is by means of light and shade, the other by showing a part of a window through which the scene was photographed.

## Photographing the Leaf

A METHOD of photographing leaves without using a camera was recently passed on to this department by Weatherman Bernard B. Whittier, of Fort Wayne, Ind. He explains the procedure as follows:

"Equipment needed: A printing frame (4 by 5 or larger); a light bulb of 60-watt or stronger; developer and hypo; and the leaves. Use only regular photo paper.

"Process: Put the leaf in the printing frame just as the film ordinarily would be placed; either side of leaf is good, best results being had by which-ever side will keep leaf most smoothly against the paper. Lock it in, backed up by photo paper, and expose quite close to the light; time will vary according to density of the leaf; say perhaps 40 seconds to two or three minutes, with a 60-watt light. Then develop and fix.

"Results: Experiments and experience will alone guide the operator to best results. The leaf comes out white against a black background, with the stems and veins in fine black lines. Even the cell structure may be brought out if the leaf is not too

## THE SCIENTIFIC AMERICAN DIGEST

(*Continued from page* 393)

more precise measure is needed since the human judge has been shown to vary in his judgment under different conditions within the same day—for that matter within the same hour.

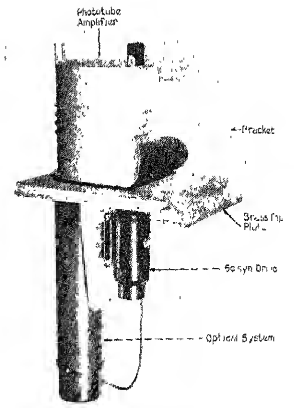
Many factors probably influence meat flavor—physical, chemical, and psychological. The texture, the degree of tenderness, and the juiciness of a piece of meat have much to do with a human judge's reaction. His own experience, his physical and mental condition also have influence. It is believed the chemical nature of the extractives responsible for flavor hides some of the secret.

The chemistry of meat flavor is extremely difficult to measure since the compounds responsible for flavors seem to be present in minute amounts. It has been established with considerable certainty that flavor carriers are water soluble. They are products of enzyme action or of oxidation due chiefly to heat and are much more in evidence in cooked meat than in raw meat. The chemical make-up of these compounds and their behavior under subjection to enzyme action and oxidation remain to be learned.

Blindfolded judges have found that the better known meats—beef, veal, pork, and lamb—cannot consistently be differentiated, and that pork and beef have the most intense flavor. Aging and ripening of meats have always been considered as developing new, and to some, more appealing flavors. The southern ham is a good example of this practice. The new flavors are apparently due to disintegration products of protein and fat brought about chiefly by enzymes.

### To Remove Skew from Cotton Cloth

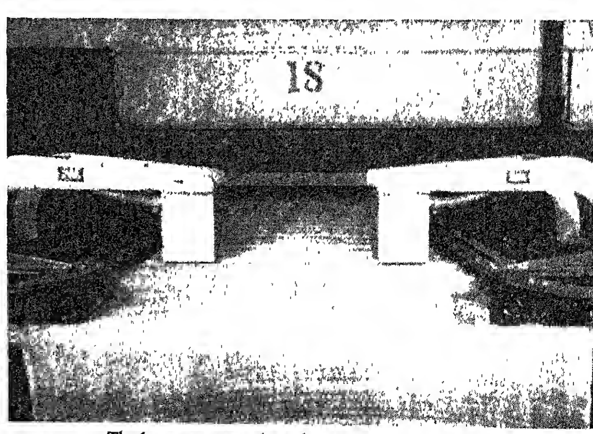
WITH the increasing demand for better quality cotton fabrics, the textile industry is faced with the problem of producing uniformly straight cloth at higher speeds. As an important aid in meeting this demand, General Electric has developed a new photo-electric control for operating a cloth-straightening device which removes skew (deviation from straightness) from cotton cloth during the tentering or stretching process. Where patterns are to be printed on a cotton fabric, it is additionally important that the weft, or crosswise threads, be square with the warp, or lengthwise threads, because figures or patterns printed on a distorted weave will themselves be distorted when the printing process is complete. The new control, which assures straighter cloth at higher speeds, also reduces operator fatigue.

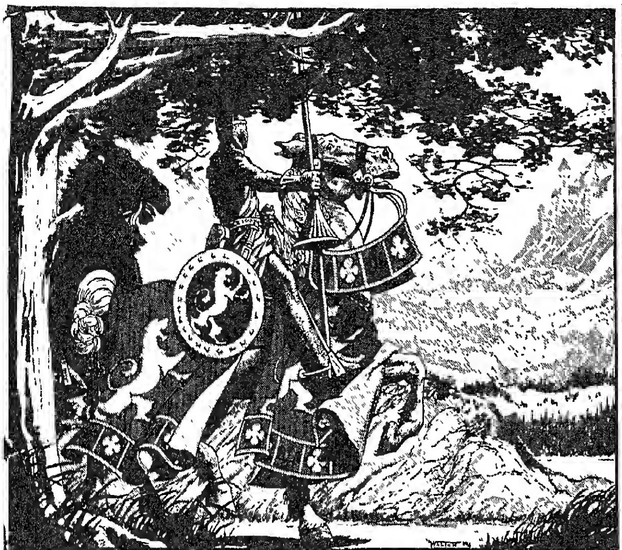



The weft-straightening control, using a photo-cell and light source

The operation of the new control centers around two photo-cells which are mounted over the cloth, one on each side of the tentering machine. Light sources are located beneath the cloth and directly under the photo-cells. As the cloth progresses through the tenter, the cells receive an equal number of light flashes between threads if the cloth is straight. If the cloth becomes skewed, however, one tube receives more frequent light flashes than the other. In consequence, the frequencies on the tubes will be unequal and, by means of amplifiers and a frequency responsive circuit, this inequality of frequencies will operate relays which, through a magnetic switch, control the operation of a straightening motor. This motor, in turn, advances or retards one edge of the cloth with respect to the other, thereby removing the skew.

The control is sensitive over a wide range of operation. Cloth speeds may vary from 20 to 140 yards per minute, and the weft-thread count may vary from 20 per inch in open woven curtain material to 100 per inch in closely woven shirting. Several installations of the new control are already in suc-





An example of work done with the drawing-toning paper described below

...sful operation, functioning as an important part of complete weft-straightening equipment built by the Winsor & Jerauld Manufacturing Company.

## Washing Dishes Clean

THE addition of sodium metaphosphate to the water used in dish washing machines not only softens the water but materially improves the cleanliness of the dishes. A recent study of the problem of dish washing at the Mellon Institute of Industrial Research has developed the fact that bacteria are frequently trapped in the insoluble soap which deposits as a film on dishes washed in hard water with ordinary soap. The usual water softening agents (trisodium phosphate, sodium carbonate, and so on) form precipitates with the calcium and magnesium in the water, and these similarly trap bacteria. Although its bactericidal action is not great, sodium metaphosphate makes dishes cleaner and freer of bacteria by preventing the formation of films or precipitates with the salts present in the water.—*D. H. K.*

## Draw and Tone

A NEW drawing paper, which provides halftone effects so that commercial artists and layout men in the graphic arts may improve greatly upon line cuts and yet get their engravings at line-cut cost, has recently been placed on the market. This new paper, called "Doubletone," is sensitized with chemicals that are not visible until they have been "developed" by other chemicals laid on with brush or pen.

In using Doubletone, sketches are made the same as on any other drawing paper. Then the dark tones are brought out with a dark tone developer. After these are developed, light tones are brought out by the application of a light tone developer. In both cases, the developers are blotted as fast as they are applied instead of being permitted to dry. The result is that the artist can practically create a highlight halftone in the original drawing. In fact, four shades can be produced—white, black, and two tones of gray.

This new paper is particularly useful at points where Ben Day effects are desired, yet the cost is considerably less. An accompanying illustration gives an idea of the effects that can be obtained.

**LABOR!**

**JAPAN has just drafted a bill to make an 84-hour week universal in Japanese industry as a means of improving national health, according to the *Associated Press*. It is noted further that a 15-hour day has been usual during the present boom in the munitions industry.**

## Cheaper Lithium

BY utilizing a new process to recover lithium from its ores, this valuable element is expected to be made more useful and cheaper. The most plentiful ore of lithium is spodumene, a complex lithium aluminum silicate which occurs in South Dakota, North Carolina, and Maine. Usually it is associated with other minerals and the new process developed by the United States Bureau of Mines makes its separation in relatively pure form quite simple.

The process consists of heating the mineral in a lime kiln which converts spodumene to a chalky white mass that crumbles easily to a powder without similarly affecting other minerals mixed with it. By sifting the resulting powder away from the larger particles of other minerals, a dust of the lithium mineral of 80 to 90 percent purity is obtained. In this form it is easily adapted to chemical treatment. The process is so simple that it can be carried out in small homemade kilns and is expected to make lithium compounds much cheaper and thus broaden their usefulness.—*D. H. K.*

## Staple Fiber, Newest in Rayon

FOR years rayon was produced and used exclusively in the form of a bundle of continuous filaments twisted together to

produce rayon threads. Recently, increasing quantities of rayon have been appearing in fabrics in the form of staple; that is, short discontinuous filaments twisted together in a manner similar to cotton or wool threads. Initiated by countries that wished to be independent of King Cotton and Queen Wool—for example, Italy and Germany—the development has spread rapidly to all the larger rayon producing countries. Staple rayon constituted only 1.5 percent of the world's total rayon production for 1930. It rose to nearly 21 percent in 1936, in spite of a 233 percent increase in the total rayon produced during the same period.

Developed originally as a substitute fiber, it is rapidly carving a textile niche of its own. It was discovered that alone or mixed with cotton or wool it produces a soft, fluffy fabric of subdued luster having good strength, handling, and draping qualities. In blends it may be cross dyed with interesting results. Entering a market in which novelty, style, and surprise dominate, rayon staple is proving to be a fascinating and effective tool in the hands of fabric designers and stylists.

As a man-made fiber, its future is limited only by the boundaries of imagination. It can be produced in any size filament or length staple or degree of luster. For rayon staple to improve in quality and strength and to be modified to meet varying requirements would simply be carrying forward the tradition of rayon itself.

The market price of rayon staple is approximately one half that of continuous rayon. In place of the usual thread of 40 or 100 filaments collected in a separate package and processed separately, the staple thread begins with 1300 to 2000 filaments. Then over 100 of these are gathered into one "tow," which can be either machine-cut to the desired staple and then processed in bulk form, or else processed in "tow" form and then machine-cut to staple length. Enormous productions are possible at low machine and labor cost.

Rayon staple is quoted at about twice the figure for raw cotton. However, some reduction in production cost is still probable. A more complete recovery of chemicals and a more efficient equipment for producing "spinning dope" should not be far away. However, with the 1936 rayon staple consumption in the United States only 0.7 percent that of cotton, there is no great rivalry between the two. Rayon has always assisted the sale of cotton in most markets and the case of rayon staple will doubtless be no exception.

## Ape That Ate Like Man Puzzles Science

WHERE, oh where, on man's family tree to hang an ape-brained creature with strangely human teeth. This problem ape that ate like a man was recently thrust into the scientific limelight at the International Symposium on Early Man in Philadelphia.

From South Africa, where it has rested in a cave for thousands of years, the extraordinary skull of this ape has emerged into a world that has living apes and men, but not missing links like this.

Dr. Robert Broom, of the Transvaal Museum in Pretoria, reported his recent finding of the skull, and displayed a cast so that his fellow pre-historians might inspect the long, narrow chimpanzee type of skull with meager brain capacity, and the almost human mouth.

Dr. Broom tentatively gives this ape the distinction of revealing a new species. It bears the name Australopithecus Transvaalensis Broom. It lived, he has reason to believe, about the middle of the Old Stone Age or even the latter part. And that is one of the most puzzling suggestions about it. For by that time in pre-history, men were no novelty on earth. Various species of man had evolved and some had already become extinct. If this South African ape was on the way to human evolution, it must have started extremely late. And it never arrived. Dr. Broom told of unearthing the skull while he was searching South African caves in hope of solving another ape puzzle. Twelve years ago, Prof. Raymond Dart had announced the startling discovery of this other ape, called the Taungs ape, which he considered the long-looked-for missing link and a near common ancestor of ape and man.

"As the Taungs skull belonged to a child ape, four or five years old," said Dr. Broom, "this was not entirely convincing to the scientific world, and it seemed necessary possible to get an adult specimen."

Comparing the Taungs skull with the one now revealed, Dr. Broom said:

"The skull is manifestly closely allied to the Taungs ape, but I am placing it in a new species because the associated mammals are all different, and I think later."—Copyright 1937 by *Science Service*.

### POCKET CHANGE

DURING the first five months of the fiscal year 1936-37, the Treasury Department put into circulation 27,939,000 dollars' worth of halves, quarters, dimes, nickels, and pennies—more than the total for the five fiscal years beginning 1930. The biggest increase was in nickels of which few were produced in depression years and only 1000 dollars' worth in 1932.

## Synthetic Resin Bearings

TRAVELERS recently returned from Germany report the wide use of synthetic resins to form bearings of even heavy machinery. The point in this practice is to reduce the necessity for importing into Germany metals customarily used in babbit and bronze bearings. Synthetic resin bearings can be lubricated with water instead of oil and are said to be giving satisfactory service under a wide variety of conditions of loads and speeds.—*D. H. K.*

## Science Promotes Peace Not War

SCIENCE, instead of promoting war, actually holds the key to the ultimate solution of the problem of peace, Dr. C. C. Furnas, Yale professor of chemical engineering and author of "The Next Hundred Years," recently told the American Institute in New York, notes *Science Service*.

"It takes a long-time view to believe this," he explained, "but it is true even if slow."

Some feel that science is merely an in-

strument of suicide because of its contribution to the deadliness of war, he said. The mob-stirring abilities of super-nationalistic maniacs do not seem to him to be dependent in any way upon the effectiveness of science. They can act more quickly than they used to but they will be eliminated more quickly too.

"Modern war with its destructive potentialities is no more destructive of life than the old fashioned kind—with its attendant pestilence," Dr. Furnas continued. "The Thirty Years War with the crudest of weapons succeeded in laying waste northern Europe and directly causing the death of between eight and twelve million persons, more through starvation and pestilence than combat. A race bent on suicide will turn the trick if it has to resort entirely to stone axes.

"Modern equipment increases the speed of the reaction but doesn't change the final result. Science further holds this important ace—it has the ability to reduce economic pressure because productivity per man, per acre, per hour, per anything is rapidly increasing; hence in the long run there will be a gradual diminution of economic pressure in certain groups. Since Germany can and is making nitrate fertilizers from the air, artificial rubber from limestone and coke, motor fuels from coal, there is less high-pressure demand for these commodities than there would otherwise be. The demands of peoples are gradually being limited to a few basic commodities such as coal, iron, lumber, cotton, and potash. It simplifies the picture of international relations and demands, hence raises hopes of peaceful solutions.

"Economic pressure is one, if not almost the sole fundamental cause of war. It is only through the application of science that we can hope to have a universal standard of living high enough to ease this pressure which is the virus of the greatest mental disease of the world."

Dr. Furnas said that science and technology are taking us toward a longer and better life and doing it relatively swiftly. If the world can for a short while keep the super-patriots from cutting the jugular vein of civilization, he believes we shall find applied science leading us into the wide rolling sea of the good life.

"Only the most rabid optimist could say that life is yet 'good' for the average man," he said, "but give us time and it will be. The critics of science are impatient. The scientists are just beginning to get steam up. With the help of the crowd, or perhaps in spite of it, they will soon begin going places."

### Fish Research Project

THE first co-operative research project in the management of fish in the United States has recently been initiated at the University of Michigan by the American Wildlife Institute of Washington, D. C., according to a recent communication from this Institute. This project is under the supervision of Dr. Carl L. Hubbs, Curator of Fishes of the Museum of Zoology, University of Michigan, and a member of the Technical Committee of the American Wildlife Institute.

Karl F. Lagler, graduate of the University of Rochester, is in charge of the work which will undertake a study of the enemies of fish and their control to permit a greater ... process are that it

production of game fish for anglers. This study will devote most of its time to the enemies of trout.

Predation of one wild species on another is a subject of great controversy. The present project is designed to find out positively, in a thoroughly scientific manner, unbiased by prejudice or predilection, just what enemies are serious factors in the lives of trout and what is their effect, for good or bad. Further, where the influence of certain trout enemies is found to be bad, it will attempt to ascertain deterrent measures without resorting to killing.

The striped bass is the subject of another study being undertaken under the American Wildlife Institute's program at Yale University, under the direction of Daniel Merriman. This bass is of great importance as both a commercial and a game fish on the Atlantic coast and on the Pacific where it was introduced from the eastern seaboard many years ago. Uncontrolled take has reduced this fish alarmingly and the present study is being undertaken to determine means of restoring and maintaining this valuable species, in more nearly adequate numbers.

### HOUSEHOLD HIKER

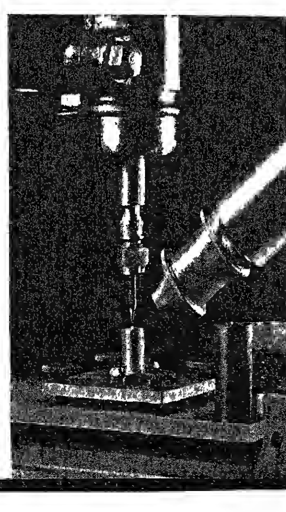
THE average housewife walks some five miles daily in the pursuit of her household duties, says *Food Industries*, adding: "Probably at least two miles is in pursuit of a can opener."

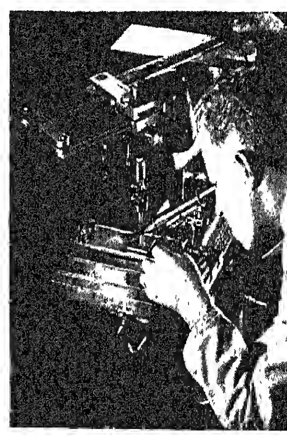
## Machine Engraves 300 Legible Characters in .005" Circle

EVERY few years we read in the daily press about the remarkable feat of some engraver who has inscribed by hand the Lord's Prayer on the head of a pin. Now a machine comes along which far eclipses this achievement, and demonstrates beyond question the superiority of the machine over hand craftsmanship, by engraving the prayer on a pin *point.*

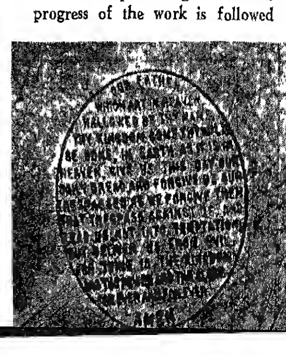
The feat was accomplished at the plant of the George Gorton Machine Company at Racine, Wisconsin, at the suggestion of the National Machine Tool Builders' Association, using a standard Gorton duplicating machine. The machine engraved all 300 characters within a circle .005 of an inch in diameter, about twice the diameter of a human hair, or equivalent to the point of a rather dull pin. A pantograph arrangement was used, by which the prayer, which had previously been printed within a circle about two inches in diameter, was duplicated in these microscopic proportions.

These machines are used industrially for reproducing dies, molds, and the like.





*Above:* The machine with which extremely fine engraving is done. *Below:* Enlargement of engraving in a .005 inch circle. *At left:* Close-up view of the engraving point and the microscope through which the progress of the work is followed



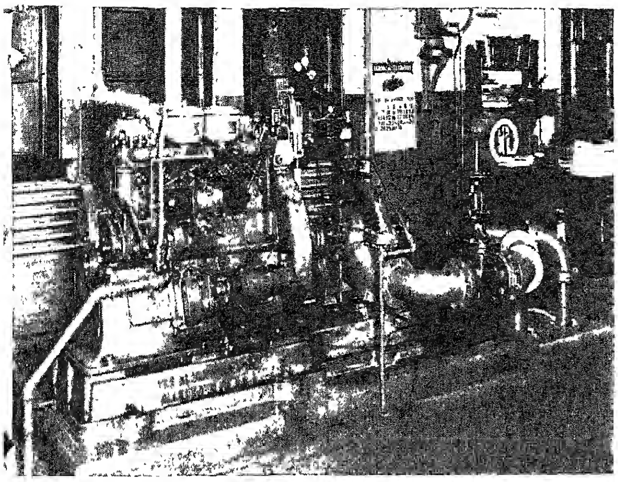
## Mineral Sticks Its "Finger in the Dike"

A SCIENTIFIC mineral counterpart of the legendary Dutch boy who stuck his finger in the dike and saved the Netherlands from disaster, was described at a meeting in New York of the American Institute of Mining and Metallurgical Engineers. Engineers are already using the mineral to seal dams and the walls of reservoirs, declares *Science Service*, and the possibilities of use in levees along the Mississippi and Ohio Rivers cannot be disregarded.

The sealing mineral is known as bentonite, a form of clay, which has the curious property of absorbing from three to seven times its volume of water and expanding to more than six times its original volume.

Oliver Bowles, U. S. Bureau of Mines, and chairman of the Institute's Industrial Minerals Division, told how a soupy mud is made of bentonite and forced, under pressure, into sand or gravel beds.

The slurry, as the engineers call it, coats



Interior of the fully automatic Diesel water-pumping station

the grains of sand or gravel, fills the voids between them and makes the whole mass water-tight even under high pressure. When ing occurs, the bentonite shrinks and ngs tightly to the sand or gravel. But as on as leakage occurs the bentonite takes up the water, swells again and reseals the entire mass.

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### KILLERS

CROWNED hawk-eagles, large birds of the South African forest, are big, heavy, ferocious; their very appearance inspires terror. A favorite prey is monkeys; simian skulls frequently litter the ground beneath their nests. They kill with a sudden blow of their large feet.

## First Automatic Diesel Pumping Station

ON December 7, 1936, the Municipal Pumping Station at North Easton, Massachusetts, completed its first full year of operation with power supplied entirely by Diesel engines. This station was the first in the country to have a fully automatic, Diesel-driven centrifugal water pumping unit.

The unit consists of a 600 g.p.m. Aldrich centrifugal pump directly connected to a six-cylinder Hercules Diesel engine, operating at 1400 r.p.m.

The results of the first year's operation proved the complete satisfaction of Diesel power for pumping station installations. According to George B. Bailey of The Thermal Engineering Company, which made the installation, the Diesel engine has required a minimum of maintenance expenditure while operating over a period of more than 1800 hours, and starting and stopping six to eight times daily. With a fuel cost of 5½ cents per gallon, the Diesel unit operates at a cost equivalent to electric power at less than one-half cent per kilowatt hour.

The automatic feature of the plant is a decided step forward in Diesel engine water pumping. Prior to the development of the special automatic control equipment the continual presence of an attending engineer the automatic controls have released the engineer for other duties and consequently effected a considerable savings in operating costs.

The plant not only maintains automatically the desired pressure differential in the pumping system, but supplies as a by-product all the heat required to maintain the pumping station temperature at 70 degrees.

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## Humidity Changes Knock Values

VARIATIONS in the humidity of the air fed to carbureters of test engines apparently cause wide differences in the anti-knock rating of the fuel tested. The improved performance of automobile engines at night and in foggy weather when humidity is high has been noticed by most automobile drivers. Recent investigations have shown, however, that humidity affects the performance of different fuels quite differently, so that unless tests are made with a constant humidity in the air they may show a variation of several units in the octane number of the fuel.—*D. H. K.*

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## Ingenious Rubber Thread Process

A NEW process for making elastic rubber thread from latex has been developed and put into commercial use. Heretofore, such thread has been made by forcing latex through an orifice and coagulating the filaments in a chemical bath, whereas the new process employs neither orifice nor bath, but forms the thread by picking up the latex in grooves on a heated cylinder.

The grooves are carried on continuous ridges, so placed that, as the cylinder rotates, the grooves contact the latex in a constant level tank disposed below the cylinder. The grooves are filled by the surface tension of the latex and capillary attraction, and the filament so formed is dried by the heat of the cylinder. After a 270-degree rotation of the cylinder, the thread is stripped off, passed through a dusting bath and wound on a spool. The product of this process is known under the registered trademark "Filatex."

Claims made for this process are that it

that it does away with coagulating baths and requires less manipulation of the latex, thus leaving its natural strength unimpaired.

Since the commercialization of this process, still another method has appeared. It is Italian in origin and calls for flowing the latex into grooves etched in the surface of a heated cylinder from a super-imposed tank, then stripping by means of a roller, and finally passing the thread through a hot water bath and drying chamber before winding.

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STEEL

SCIENTIFIC improvements in alloys and rust preventives have given us steels that last twice as long as they did 50 years ago.

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## Queer Livelihoods

THE Census Bureau's manual of occupations lists about 25,000 ways of earning a living, but it overlooks mattress walkers, says the *Associated Press.*

Dr. Vergil Reed, acting director of the bureau, vouched, however, for this exclusive group.

He said that there are at least 100 professional mattress walkers in the country, earning their way walking the kinks out of mattresses. They stamp extra hard on hard spots, he said, and put the new mattress into a flat, even state.

Even Dr. Reed didn't know the duties attendant on some of the obscure occupations the manual lists.

Some which pique the imagination are "bogeyman," who works in glass factories: "secret hand," who adds a note of chill mystery to the rubber industry; the "fat man," connected with the printing business, and "tooth knocker out," who helps in meat packing houses.

Stickers-up, said the expert, pile pottery over the fire; spooners clean out holes for dynamite in coal mines; speeders run a species of textile spinning frame; neckers do about what one might expect, to sweaters in knitting mills; knifers-up have a place in shoe factories.

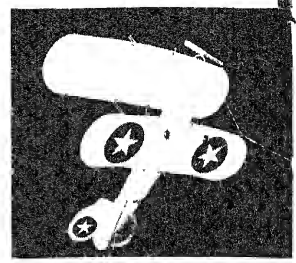
Knockers-down, off, and out, and crackers-off and open, earn livings in glass factories.

## Airplane Kite

MUCH of the original research that led to the development of the airplane was done with the aid of kites. Airplane development since then has gone far; the child has outgrown the parent, and kites have not kept pace. It is interesting to note, therefore, that a kite has now been developed which not only simulates the airplane in appearance but also performs many of the stunts that an airplane can do in the air.

Those who have seen the Trevor Wonderplane in the air say that at a moderate height it is mistaken by observers for an airplane which, strangely enough, seems to remain practically stationary. By simple manipulation of the restraining cord, it will perform loops, barrel rolls, nose-dives, and side-slips.

Two models of this plane, one $56\frac{1}{2}$ inches across the wings, and the other 46 inches, come in knock-down form ready to be as-



A kite—not an airplane

sembled by the amateur. The plane-kite can be flown in fields that are too small for ordinary model flights, since it does not require a large space for take-off.

## Vitamin D in Menhaden Oil

COD-LIVER and other oils of high vitamin content have become expensive as constituents of poultry feeds. In the search for cheaper oils to be given chickens it has been found that the oil pressed from menhaden, a fish caught in large quantities along our Atlantic seaboard, has a high vitamin potency. Menhaden oil, which is used in the manufacture of certain paints and varnishes, is considerably cheaper than cod liver and sardine oils for poultry feeding purposes. Strangely enough, young fish of low oil content yield a better grade of oil than fat, full-grown fish.

## If Gory Fingernails Annoy You

BECAUSE daylight is white light, man has a prejudice against colors such as sodium's yellow. Yet they are sometimes useful. One illuminating engineer installed a sodium lamp in his office. His secretary at first emphatically disliked the effacement of colors other than yellow. But she became accustomed to it. The engineer said that red on the secretary's fingernails did not look half so bad as it did under ordinary light.—*Science Service.*

## Paper from Straw

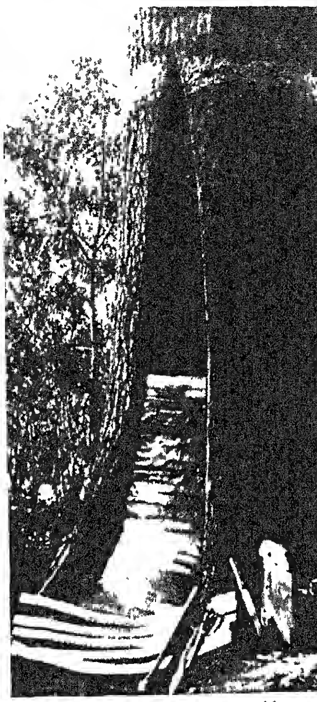
SO successful has been the manufacture of pulp and paper from wheat straw, using chlorine as the pulping agent (Pomilio process), that the plant now in operation in south Italy is to be enlarged to supply 150 tons per day of pulp. This is more than $\frac{1}{6}$ of the total paper consumption of that country and is part of the plan being pursued to make Italy independent of imports.—*D. H. K.*

## Woodman Spare That Tree—With Rubber

ONE of the most interesting examples of the skill and ingenuity employed in the art of tree surgery is the project now in progress at "Monticello," famous Virginia home of Thomas Jefferson, which is maintained by the Thomas Jefferson Memorial Foundation as a national shrine. Surrounding the house are a group of beautiful trees which, it is said, this great statesman planted with his own hands. Now over a century old, many of them are rapidly deteriorating due to rot. To combat this condition, a new

form of tree surgery is used which employs rubber for sealing the cavities after they have been thoroughly scraped of all decayed wood.

Not satisfied with the materials generally accepted for this service, George Van Yahres, well-known eastern tree surgeon, began a search several years ago for one which would be more adaptable to nature's requirements. He reasoned, and logically so, that the ideal material should be one which most nearly simulated wood. Why not use a



Major tree repair, using rubber

product derived directly from trees? His first experiments were with cork. Although possessing most of the desired qualities, it was soon found that this material had to be specially waterproofed and treated to withstand the elements, insects, and birds. The added expense made the use of this material impractical in many cases. Mr. Van Yahres then started experiments with another product which comes from trees—rubber. A few test installations convinced him he was on the right track. He then submitted his problem to development engineers of The B. F. Goodrich Company, who supplied him a rubber specially compounded to withstand continuous flexing, long exposure to sunlight, and extreme temperature changes.

This special rubber is made up in strips about 1½ inches wide by 1¼ inches thick. After the decay has been removed from the tree, the cavity is walled up with these rubber strips in much the same manner as bricks are laid. The strips are cut so that their length is slightly greater than the width of the cavity. This is done so that the ends of the strip will compress against the sides of the cavity to give an absolutely tight seal. One strip is laid upon another, each being cut so that it will exactly fit the contour of the cavity. As the wall of rubber is built up, the remainder of the space back of it is filled with a cementitious mixture designed to absorb all moisture and not shrink. The inside surface of the strips contains a series of small double dovetails which are em-

bility of their pulling away from the filling.

The use of rubber is said to offer many advantages. It provides a simple but permanent seal against air, moisture, and insects. The great flexibility of the material enables it to sway and twist with the tree without cracking, and permits natural growth of the bark over the filled area. Appearance is improved, also, as the color of the rubber is in harmony with that of the tree.

**WAGES**

THE American steel industry pays wages that are from 120 percent to 650 percent above the average in foreign steel mills.

## Comprehending the Significance of Science

RECOGNITION is growing that the history of science is one of the essential cultural disciplines. Courses in the subject are given at our important engineering schools and at several of the older universities which have long been strongholds of classicism. Scholarly books have begun to appear, and more popular books which unroll the drama of man's eternal quest for the truth and his persistent effort to turn to his perpetual advantage the new things which he has learned. These books are fascinating reading for any but sluggish minds: they appeal alike to the student of philosophy and to the lover of detective stories. Research is a high adventure.—*Industrial Bulletin* of Arthur D. Little, Inc.

## Most Powerful Motor Siren

A MOTOR siren which can be heard distinctly at a distance of eight kilometers (five miles approximately), and which is almost unbearable for people within a radius of 50 meters (164 feet), has been invented by Harald Ekman, a Stockholm engineer. Mr. Ekman has several other inventions to his credit, among them an automatic fire alarm system and a fire protection system using thermo-contacts, which are now manufactured by the L. M. Ericsson Telephone Company.

The new siren has proved to be 14 times stronger than any other previously constructed, and is estimated to be able to awaken a person sleeping within half a kilometer's radius. Experts consider that the Ekman siren solves the problem of giving effective alarm in case of air raids.

Tests have been carried out both in Sweden and in other countries. Competing against the noise of London traffic at a time when there was a wind of 10 meters (approximately 33 feet) a second, the sound of the siren was found to be audible at a distance of approximately five miles.—*Holger Lundbergh.*

## Heavy Hydrogen by Simplified Method

USING electrolysis in an apparatus constructed entirely of glass parts, research physicists of the Westinghouse Lamp Company have devised a simplified method of extracting heavy hydrogen from heavy wa-

New electrolytic apparatus with which heavy hydrogen is produced

ter to use in getting a supply of neutrons for the study of nuclear physics.

Outstanding features of the method are its simplicity and economy of operation. It requires only a small amount of heavy water, from three to five cubic centimeters, resulting in small waste, and a minimum of attention after operation begins. As seen in the accompanying illustration, the apparatus occupies a small space in the laboratory.

**FAGS**

ALTHOUGH nine billion fewer cigarettes were manufactured in 1933 than in 1929, production jumped in 1934 to a point totalling six billion more than were manufactured in 1929. Growth since then has been continued and steady.

## Fuel Gas from Pulp Waste

FUEL gas equivalent in heating value to approximately 400 pounds of coal can be obtained by the anaerobic (without air) fermentation of the waste liquor produced in the manufacture of each ton of paper pulp in a sulfite mill. This fuel gas can be obtained as a valuable by-product in the treatment of sulfite waste liquor to prevent pollution of streams. After fermentation, the liquor contains only lignin and can be dumped into streams without causing dangerous pollution.—*D. H. K.*

## Ceramic Laboratory Table Top Material

EXPERIENCE has shown that the materials commonly used in making laboratory table tops do not inherently fulfill in the highest degree the exacting requirements of such service. Wood, for example, is not fireproof; repeated applications of protective finishes are required in order that it may withstand chemical action. Asbestos, in any of its forms, is fireproof but it must have special fabrication to provide adequate strength and acid-resistance. Soapstone, one of the most generally used materials, does not long retain its smoothness and pleasing appearance because it is relatively soft and will crack or spall when subjected to local-

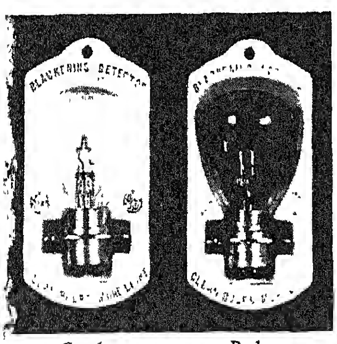
...ed heating. Vitrified tile is used in many laboratories but, because it is produced in small sections, tops made from it have many dirt-collecting joints; it is difficult with tile to attain even a relatively smooth surface.

These considerations led to the thought that it might be possible to find a material that would have none of these disadvantages. Experimental work at Mellon Institute extending over a period of years resulted in the production of a porous, non-warping ceramic body that is impregnated with bituminous substances and then heated under special conditions to form coke in the pores. Unusually high resistance to thermal shock is imparted to the material because artificial cordierite, a mineral that has a very low thermal expansion, is used in making up the ceramic body.

Thus there was produced a material that can be polished to velvety smoothness, possessing sufficient hardness to resist scratching and abrasion, ample structural and impact strength, denseness that prevents absorption of liquids, resistance to solvent action and chemical attack, and the ability to withstand perfectly the effect of rapid heating and cooling. In other words, "Kemite," as it has been called, has none of the disadvantages of the commonly-used table top materials.

## Auto Bulb "Blackening Detector"

THE silent and oft-unheeded blackening warning that headlight bulbs serve before burning out, and which if unheeded leaves the motorist with a one-eyed car, may now be readily interpreted by means



Good Bad

of an implement developed by the Incandescent Lamp Department of General Electric Company at Nela Park, Cleveland, Ohio.

The bulb-blackening detector is a small receptacle of molded plastic material into which the bulb to be tested is fitted and slowly rotated. The white background of the receptacle shows up any blackened portions of the bulb in bold contrast. Severe blackening is a certain indication that the bulb is rapidly approaching burn-out.

## Controlling Sunburn

NUMEROUS products now being marketed prevent dangerous sunburn from summer or winter exposure, but at the same time also prevent healthful tanning of the skin. These treatments take the form of chemical compounds, usually complex salicylates, included in a lotion or cream applied to the skin. A recent advance in this ... synthetic compound to be used in this way which has a selective filtering action on the ultra-violet rays of sunlight. A layer as thin as 1/300 of an inch of preparations containing 3 percent of the new synthetic prevents injurious sunburn and at the same time allows enough ultra-violet to pass to create a healthy tan and to produce vitamin D in the skin. By combining the new compound with methyl or benzyl salicylate, the quality as well as the quantity of the healthful and harmful ultra-violet rays reaching the skin can be accurately controlled. It is reported that a healthful tan can be easily secured without danger of serious burns and without losing the value to be had from vitamin D formed in the skin. Many compounds heretofore used for this purpose are too effective in preventing burns and keep the skin white without allowing it to tan naturally.—*D. H. K.*

## The Prophets Would Scarcely Know Palestine

AN account of electricity supply in Palestine since it was initiated in 1923, given recently in *Electrical Industries*, is of special interest in connection with the political rioting which began last April. The pioneer of this supply was Mr. P. Rutenberg, who enlisted the support of the late Lord Melchett and the Baron E. de Rothschild.

It was decided to have a national power supply from water-power, but as the rainfall for Palestine lasts only four months in the year, it was necessary to store the winter rainfall in reservoirs, the construction of which would take several years. It was advisable therefore to use temporary Diesel-engine power stations at Haifa and Jaffa to begin the supply, while the Dagania Dam across the River Jordan and the large one on the Tarmuck River were being constructed. In addition to these dams, Lake Tiberias, which forms a natural reservoir with a surface of 170,000,000 square meters, was utilized. The water-power is converted into electrical power which, by high-potential electricity, is distributed to Haifa and thence to the north and south of Palestine. In addition, a steam turbine power house was constructed in 1935 and a large power house is being built in southern Palestine.

When these plans are completed, the Holy Land will be as highly electrified as any territorial area in the British Empire. During the last three years, the consumption of electricity has quadrupled.

There can be little doubt that industrialization is rapidly changing the character of Palestine and that electric power is the main factor in producing this change. Electric lighting, electric power-driven machinery, and wireless sets are to be found in small towns, villages, and even in remote farming settlements. This is partly due to the fact that the immigrants, who come from Germany, America, Czechoslovakia, Austria, and the British Dominions, have been accustomed to the use of electric light in factory and home.

It looks as though schemes for flooding the Dead Sea from the Mediterranean and so getting electric power possibly for sale to Egypt will soon be considered. One very beneficial effect would be that the constant evaporation from the greatly increased surface of water would humidify the atmosphere and so contribute to the fertility of the region.—*Nature (London)*.

# CURRENT BULLETIN BRIEFS

*(Bulletins listed as being obtainable through Scientific American can be supplied only by mail)*

Technology and the American Consumer is a brief discussion of the relation of machinery to consumer purchasing power as reflected in wages of factory workers and prices of manufactured goods. It is illustrated with simplified charts which drive home pertinent facts, and contains a definite series of conclusions regarding the effect of technological development as it pertains to the average man. *Machinery and Allied Products Institute, 221 North La Salle Street, Chicago, Illinois.—Gratis.*

Brown Flow Meters is a comprehensive catalog with numerous illustrations in color giving details regarding indicating, recording and integrating meters, both electrical and mechanical. The catalog will be of value to any plant executive who has occasion to make use of such instruments. *Write for Bulletin 637A, Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

Manual of Lathe Operation and Machinists Tables is a spiral-bound book with a sturdy, flexible composition cover, which will be invaluable to anyone who operates any type of lathe either in the home workshop or in industry. Index tabs make it easy to find any particular section of the book without having to wade through a mass of other material. The book is replete with photographs and drawings that explain the text, and presents tables of materials and other pertinent data that make it complete in every respect. *Atlas Press Company, 1822 North Pitcher Street, Kalamazoo, Michigan.—One Dollar.*

Building a Career in Arc Welding describes a course in this subject that will give the student a thorough background in an industry which is constantly widening its scope. *Write for Bulletin 637B, Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

Auto Driving Hazards and a Plan to Overcome Them, by Dr. M. E. Streen, gives the author's proposed plan for reducing the reaction time of a motor-car driver, faced with an emergency, to what may be termed an irreducible minimum. This is accomplished by a mechanism which makes it unnecessary to shift the foot from the accelerator to the brake-pedal, and which also eliminates the danger of the "extensor thrust" reflex, which frequently makes the driver push down hard on the accelerator in an emergency just when he should be applying his brakes. *Dr. M. E. Streen, 908 Bergen Street, Newark, New Jersey.—25 cents.*

Some Consequences of Graphitic Corrosion of Cast Iron, by W. A. Wesley, H. R. Copson, and F. L. Laque, is a reprint of an article which originally appeared in *Metals and Alloys*. It shows that the rapidity with which such corrosion sometimes occurs may be due to local galvanic effects, and shows how nickel alloy cast irons have favorable characteristics which will give

vironments. *Write for Bulletin 637C to Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

Elevator Wire Rope presents interesting data on elevators and elevator rope and also provides a handy means of keeping records of elevator service. *Write for Bulletin 637D, Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

100 Years in Fluid Current Motors is a small booklet that presents an historical survey of the development of the screw propeller, the magnus rotor, the Panama Canal, and the phenomenon of lift by autorotation. *Charles Cottingham, 918 Grant Place, N. W., Washington, D. C.—75 cents.*

How and When to Control Insects and Diseases on Vegetables has been prepared to assist the grower in solving his insect and fungus disease control problems. The information is general in treatment since it is intended to cover the most troublesome pests found in growing areas throughout the country. *Write for Bulletin 637E, Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

Aligning Philco Receivers, by John F. Rider, is a 136-page bound book covering specifically all the models of receivers made by this one manufacturer. It includes drawings of chassis layouts of each receiver and pertinent data on their adjustment. *John F. Rider, Publisher, 1440 Broadway, New York City.—One dollar postpaid.*

Pleasure and Profit with the Handee is essentially an instruction book for the home workshop owner in the use of those little portable hand-size grinders that are becoming increasingly popular. The book tells how to construct various fixtures that will make the use of the grinder more flexible, and also gives many hints on doing work other than ordinary grinding. It also tells how to work with various materials, including plastics and metals, and devotes a couple of pages to the use of these little machines in working on automobiles. *Write for Bulletin 637F, Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

Lignum-Vitae Fact Flashes is a small folded publication which appears at regular intervals and which gives detailed data regarding this hardest of hard woods. Lignum-Vitae has many uses in various industries because of its hardness, weight, density, and close grain, as well as its self-lubricating and acid-resisting properties. *Lignum-Vitae Products Corporation, 96-100 Boyd Avenue, Jersey City, New Jersey.—Gratis.*

Modern Cornell Doors—Upward Acting describes and illustrates metal and wood doors and grilles suitable for closing all types of openings in shops, factories, and garages. *Cornell Iron Works, Inc., 36-20 13th Street, Long Island City, New York.—*

# LEGAL HIGH-LIGHTS

## Patent, Trademark, and Related Legal Proceedings That May Have a Direct Effect on Your Business

By ORSON D. MUNN, Litt.B., LL.B., Sc.D.
New York Bar
Editor, Scientific American

### Belligerent Trolley Car

A TROLLEY car is generally regarded as an instrumentality of peace and quite remote from machine guns and similar implements of warfare. Nevertheless, in a recent decision of the Court of Customs and Patent Appeals, a patent for an ammunition counter on a machine gun was rejected on the basis of a prior patent for a motorman's recorder for a trolley car. The ammunition counter which was sought to be patented was designed to be used with a machine gun for indicating the number of rounds of ammunition fired by the machine gun. The Court of Customs and Patent Appeals found that a prior patent disclosed a similar counting mechanism for counting the rotations of one of the wheels of the trolley car to indicate the distance travelled.

The applicant for the patent on the ammunition counter for machine guns contended that trolley cars were so remote from machine guns that there was no relationship between the two and that he was accordingly entitled to a patent on his counter. The Court disagreed with the applicant, however, and held that he was not entitled to a patent. In reply to the applicant's argument as to the differences between machine guns and trolley cars, the Court stated:

"It does not seem to us that the broad difference between the arts of street car operation and machine gun firing are decisive of the issue here. The actual art is numbering or counting, with a display of the result at a desired location, and we regard such art as being the same in both * * * *."

### Futile Utility

CAN a patent be obtained on a new use for an old machine? Inventors frequently ask this question and the answer is that, generally speaking, a new use for an old machine cannot be patented. If the new use amounts to a new process, the process can be patented. However, the old machine cannot be repatented merely because a new use for it has been discovered; nor can the normal function or mode of operation of the machine be patented. This principle of law frequently works hardships on inventors because at times the discovery of a new use for an old machine does require that spark of genius frequently associated with invention.

In a recent suit for patent infringement before one of the United States Circuit Courts of Appeals, the Court gave consider- was for a surface condenser which the inventor described as operating in a particular way to produce a desired result. The Court found that a prior British patent disclosed a surface condenser of similar construction but which was intended to be operated in a different manner to produce a different result. The Court concluded that the patentee had merely discovered a new use for an old condenser and that the new use was not patentable. In this connection the Court stated: "It may require the spark of genius to discover a new use for an old machine, but the law does not make that patentable when, as here, it does not amount to a new process, since it is not any 'new and useful art, machine, manufacture, or composition of matter' or any improvement of them."

### Punch Board Sales

A FEDERAL Circuit Court of Appeals recently sustained an order of the Federal Trade Commission directed against a candy manufacturer which, among other things, ordered the candy manufacturer to cease and desist from supplying punch boards or similar devices to dealers purchasing the manufacturer's candy.

The Court found that the manufacturer sold candy assortments consisting of a large number of uniform small candy bars of the size and kind usually retailing for five cents each and of a small number of larger candy bars. The purchaser of the assortment was supplied with a push card or punch board made of stiff pasteboard with covered holes in each of which was concealed a number. Certain of the numbers designated the larger size candy bars. For five cents a customer was entitled to uncover any number on the punch board and if he uncovered one of the lucky numbers he received a large bar. Otherwise he received the standard bar of the size generally retailing for five cents. The Court sustained the contention of the Federal Trade Commission that this was an unfair method of doing business and affirmed the order to cease and desist the supplying of punch boards to dealers and jobbers purchasing candy.

A prior decision of the United States Supreme Court had held that the use of the element of chance in selling merchandise was an unfair method of competition. The candy manufacturer contended that there was no element of chance in that the customer always received at least five cents' worth of good candy and therefore there was no possibility of loss to the customer. The Court disagreed with this contention, stating that the removal of all possibility effective. In conclusion the Court stated:

"A method of sale which employs the element of chance as an essential feature is against public interest because it is in the nature of a gambling game" . . . and that "such a method is unfair competition because it places competitors in the position where they must unwillingly adopt such method or run the risk of losing business if they refrain from so doing."

### Artistic Invention

IS a design the product of invention or of artistic genius? Unquestionably a design is popularly considered to be an artistic creation. Nevertheless, as a matter of law, a design must be the product of invention to be proper subject matter for a design patent.

In a recent case decided by a Federal District Court, the Court held a design patent invalid as lacking in invention. The patent related to a design for an automobile radiator cover in which the cover was cut so as to fit over the lower portion of an automobile radiator. A slit provided with a "zipper" fastener extended from the top of the cover to a point below the center thereof and a pair of garnishing strips were secured from the upper corners of the cover to the center of the bottom thereof so as to form a V. The Court found that the radiator cover did not embody a patentable design, and in reaching this conclusion stated:

"Some exercise of the inventive faculty is as essential to the validity of a design patent as to the validity of a mechanical patent. * * * In order to involve an exercise of the inventive faculty, a design must be shown to be beyond the range of the ordinary routine designer. * * * To add to such a cover an ornamental V cannot be said to constitute invention."

### Beware

THERE are operating throughout the country a number of corporations employing in their title the words "patent," "trademark," "design patent" or "copyright," combined with the words "specialist" or "bureau" in such a way as to give rise to the presumption that they are of an official or semi-official nature. In most instances the personnel of these organizations are not attorneys nor are they bound in any way by the ethics or standards of the legal profession. It has been the practice of such organizations to solicit the business world, offering to secure trade-mark registrations, design patents, and in some instances, but more rarely, patents.

A recent instance has come to our attention where one of these so-called "bureaus" advised a manufacturer that it could secure for him a monopoly on a certain dress design which had been used as a staple design by the trade generally for a period of years. Relying on this assurance the manufacturer invested heavily in seasonable materials. The Patent Office search did not disclose the design and a design patent was issued.

The natural result was that when the manufacturer attempted to secure an injunction restraining other manufacturers from making a dress embodying the particular design in question, his injunction was refused, and he found himself in the embarrassing position of having contracted for great quantities of material which he will be unable to

# Books SELECTED BY THE EDITORS

### MATHEMATICS FOR THE MILLION

*By Lancelot Hogben, F.R.S.*

A NOTED scientist, not primarily a mathematician, wrote this book in a hospital during a long illness and for fun. His aim was to help millions who have "forgotten their mathematics" or who run when mathematics leers at them, yet secretly wish they could cope with the bogey. Many able critics think he has succeeded. Figuratively, instead of doing his best to keep the poor sufferer mystified—as many writers of mathematics textbooks do—he takes the scared-cat by the hand and leads him beside still waters. The main chapters are: Translating Number Language; Euclid Without Tears; Arithmetic; What We can Do with Trigonometry; Algebra; Logarithms; Calculus (which it really explains in plain language). This reviewer, one of the scared-cats, often suspects that many writers of books that make mathematics "easy" are cheerful liars, and that "painless" mathematics is of a piece with "painless" dentistry. But the present book comes closer to having a heart than any other he has seen. Still better, it hasn't the usual earmarks of those old school books but is a pleasant book to look at and handle—nice printing. 650 pages. —$3.95 postpaid.—*A. G. I.*

### SALT WATER FISHING

*By Van Campen Heilner*

SHEER joy of writing about a subject that has been virtually the author's whole reason for existence shows through every page of this 452-page volume. Covering all forms of angling in salt water from flounder fishing to the pursuit of monsters of the deep, the text is an easily readable combination of anecdotes and practical information. Almost 150 pages are devoted entirely to action photographs. Sprinkled through the book are 12 beautiful full color reproductions of paintings of fishing scenes. This volume is certainly a "must" for every fisherman's library.—$5.20 postpaid.—*A. P. P.*

### THE REALM OF THE NEBULAE

*By Edwin Hubble, Mount Wilson Observatory*

THE realm of the nebulae is the known universe beyond our own nebula, the galaxy; and this book shows, step by step through the stages of reasoning, how the astronomer attempts to work out its arrangement. It is not simple and is only semi-popular, nor on the other hand is it abstruse. In short, it is just such a book as an amateur astronomer who had already read seriously one or two textbooks of astronomy would regard as a nice piece of study, giving a semi-professional insight into professional astronomers' methods without getting in beyond the average man's depth, and coming out at the end on very familiar terms with the orderly wheels of the universe.—$3.15 postpaid. —*A. G. I.*

### IN QUEST OF GORILLAS

*By William K. Gregory, Curator of Comparative Anatomy and Ichthyology, and Henry C. Raven, Associate Curator Comparative Anatomy, American Museum of Natural History*

THE two authors describe an expedition across central Africa in search of a perfect specimen of a full grown gorilla for scientific study. The account contains numerous side-lights on natural history and geology of Africa, but is mainly a narrative of a grand trip, and a lively, most readable account at that. It has been chosen as a Scientific Book Club selection as well as a Book-of-the-Month Club recommendation.—$3.70 postpaid.—*A. G. I.*

### HANDBOOK OF ENGINEERING FUNDAMENTALS

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### CHAMPLIN ON FINE GRAIN

*By Harry Champlin*

MR. CHAMPLIN reveals himself in this book as that rare combination of a scientist who is also able to write in the language of the man in the street. The author, whose formulas for fine-grain development of miniature films have created a sensation among amateur photographers, has worked conscientiously and productively over a long period of time on a problem that has troubled a great many people. That he has now, with his head crammed with scientific facts unfamiliar to the average amateur photographer, been able to sit down and clarify the whole fine-grain problem so that anyone can understand it, makes the publication of his book news of first rate importance. His book describes various formulas in current use and explains how he compounded his own formulas, what ingredients they consist of, and why he used each particular chemical included. He explores the entire subject from A to Z and, incidentally, offers a complete handbook, remarkably compact, on the proper methods of making fine-grain negatives and printing enlargements from them. Besides containing an analysis of the various formulas which have been published by him from time to time, this book reveals for the first time anywhere his newest formula, Champlin No. 15. —$1.90 postpaid.—*J. D.*

### THE ROMANCE OF THE CALENDAR

*By P. W. Wilson*

A VERY readable account of the origins and development of the calendar, with full discussion of the question of calendar reform.—$3.15 postpaid.— *A. G. I.*

### THE TRAILER HOME

*By Blackburn Sims*

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### ORGANIC CHEMISTRY

*By Dr. Frank C. Whitmore*

PRIMARILY intended as a reference work, Whitmore's "Organic Chemistry" is the first and most complete compilation of information about organic compounds in the English language. Investigators in the past have had to rely for their information on books in other

languages, particularly German. Dr. Whitmore has put together what amounts to a whole library about the compounds of carbon in a single volume of convenient dimensions. The index, which is the best guide to the amount of information contained in this volume, is made up of some 49,000 items. These cover the gamut of organic chemistry from the simplest hydrocarbons through and including the very complex compounds known as alkaloids involving chains of rings in their structures. The brevity of treatment omits unessential details but allows the inclusion of the widest possible range of subject matter. The book is obviously of immense value to those qualified to interpret its condensed information—practicing chemists and advanced students.—$7.75 postpaid.—*D. H. K.*

## SNAKES AND THEIR WAYS

*By C. H. Curran, American Museum of Natural History, and Carl Kauffeld, Staten Island Zoological Society*

THE following statement by William Beebe well characterizes this book: "The volume presents, I believe, the first thoroughly general treatment of serpents. I have enjoyed reading it and can heartily recommend it."—$3.75 postpaid.—*A. G. I.*

## THE DICTIONARY OF PHOTOGRAPHY

*By E. J. Wall, F.R.P.S., edited and largely rewritten by F. J. Mortimer, F.R.P.S.*

THIS is the 14th edition of a reference work for amateur and professional photographers, the success of which is sufficiently indicated by the number of editions which have been absorbed since its first publication. To those unfamiliar with the book, it must be stated that it is in reality an encyclopedia of photographic information rather than a dictionary of terms, in addition to which it contains useful instruction, much of which is extended almost to hand-book proportions. The present edition has been edited by Mr. Mortimer to include the most recent advances in photographic technique, thus making it as useful to the contemporary worker as it has been to those who have found it helpful and instructive in the past.—$3.20 postpaid.—*J. D.*

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A SMALL book about various old age pensions and plans, including the one precipitated on us from Washington, D. C. Whether "correct" or not we do not presume to state, having troubles aplenty already and doubting whether the ideal of correctness in such things is anywhere attainable. However, it is interesting.—35 cents postpaid.—*A. G. I.*

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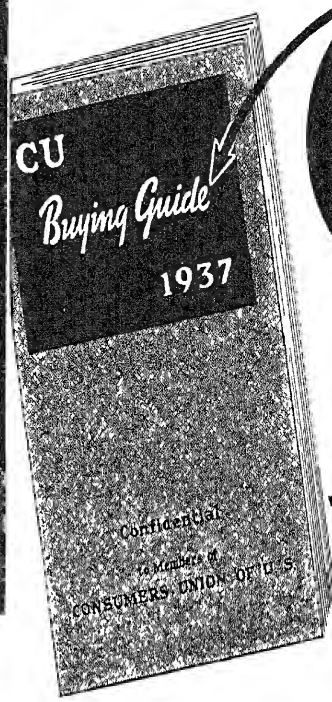


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# A Case Report

"The patient was desperately ill, restless, apprehensive and unable to talk. Difficulty in breathing was pronounced. The breath had a foul gangrenous odor. The tonsils and pharynx were inflamed and showed areas of ulceration covered with a firmly adherent, dirty greyish-black membrane. . . . Despite intensive treatment which included 2 blood transfusions, the patient became progressively worse and died on the day following admission . . ."

*(Digest of a medical report of an actual case of agranulocytosis, a disease caused by aminopyrine.)*

Have you ever heard of agranulocytosis? Or aminopyrine? Probably not. The first is a disease, discovered only a few years ago and responsible for more than 1,500 deaths in the United States alone during a three year period. The second is a drug—the direct cause of agranulocytosis. It is contained in many widely-advertised headache and pain remedies. Despite warnings against its use by the medical profession and the United States government this deadly drug, under a variety of brand names, is sold freely in great quantities.

There may be aminopyrine in your medicine chest—without your knowing it. If you want to be sure that you're not unwittingly using this drug read the article on "Aminopyrine" in the April issue of *Consumers Union Reports*. Prepared by competent medical specialists, it tells what agranulocytosis is *and lists by brand name a number of proprietary and patent medicines which contain aminopyrine.*

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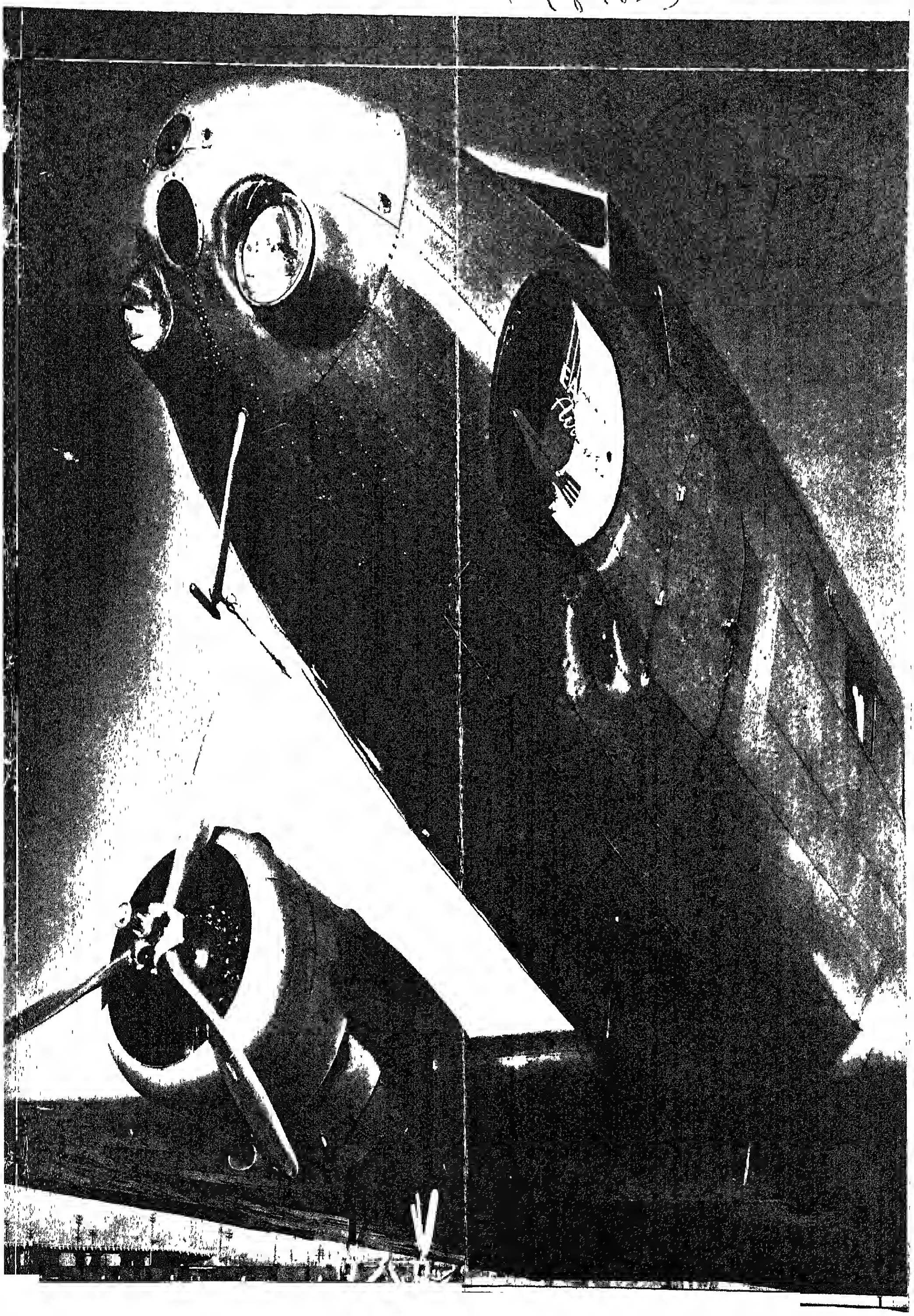

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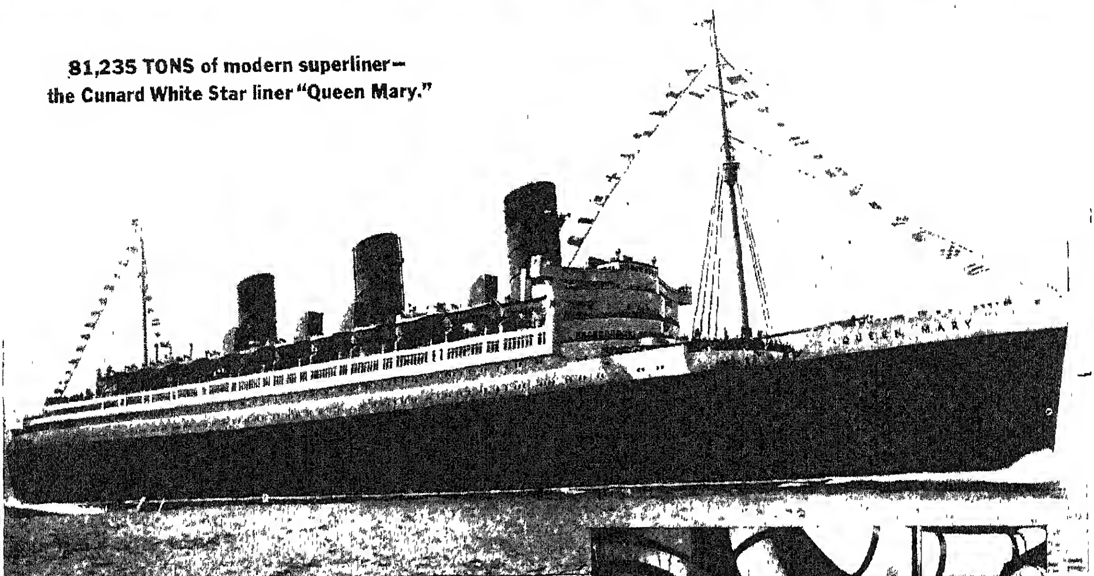

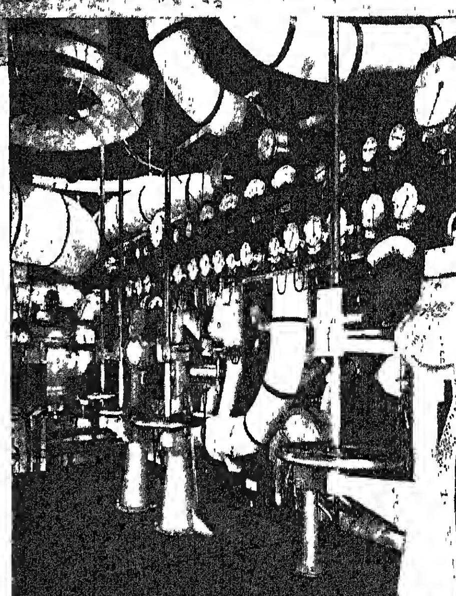

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## "Queen Mary" engines illustrate HIGH COMPRESSION feature of modern autos

MARINE ENGINEERS now get more power out of every gallon of fuel oil by super-heating steam—increasing operating pressures. Automobile engineers give you more from every gallon of gasoline by increasing compression ratios—building modern cars with high-compression engines.

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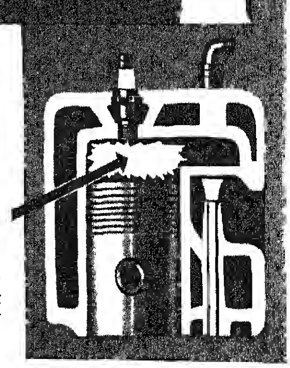

FUEL mixture is compressed in the cylinders of the average modern cars to less than one-sixth its original volume. You need ETHYL to prevent "knock" under this HIGH COMPRESSION.

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NINETY-THIRD YEAR • ORSON D. MUNN, Editor




## CONTENTS · JULY · 1937



TYPIFYING modern air transport—so largely dependent upon reliable high-powered engines discussed in detail by Reginald M. Cleveland on page 14 of this issue—is the striking photograph of an Eastern Air Lines passenger plane reproduced on our front cover. This particular ship is a Douglass DC-2, powered by Wright Cyclone engines of 750 horsepower each.




SCIENTIFIC AMERICAN, July, 1937. Vol. No. 157, No. 1, entered at the New York, N. Y. Post Office as second class matter June 28, 1879, under the act of March 3rd, 1879; additional entry at Greenwich, Conn. Published monthly by Munn & Company, Inc., 24 West 40th Street, New York City. Copyrighted 1937 by Munn & Company, Inc. Great Britain rights reserved. Subscription price $4.00 per year. Canada $4.50. Foreign $5.00. Manuscripts are submitted at the author's risk and cannot be returned unless accompanied by postage.

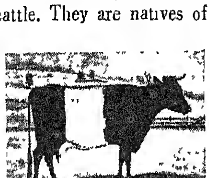
# 50 Years Ago in . . .

## Scientific American

*(Condensed From Issues of July, 1887)*

FLASHLIGHT—"Messrs. Goedicke and Miethe have prepared a mixture of pulverized magnesium, chloride of potash, and sulphide of antimony, which when ignited produces an explosive, lightning-like illumination of such intensity that by means of it an instantaneous photograph can be taken."

CATTLE—"We present a portrait of an excellent representative of a unique and novel breed of dairy cattle. They are natives of Holland and antedate the seventeenth century, when the cattle interests in Holland were in the most thrifty condition, and this type and color were established by scientific breeding. . . . In their native country they are owned and controlled by the nobility, and present a very novel feature in the landscape, grazing in the lowlands in Holland. In color they are black, with a continuous white belt around their body, the white being pure white, the black jet, making a beautiful and imposing contrast. Their form is usually very fine, and they are wonderfully productive as milkers."



PANAMA CANAL—"The present condition of the Panama Canal was explained to the American Society of Civil Engineers . . . by Mr. T. Boulange, one of the chief engineers at the Isthmus on the great undertaking, who arrived from Panama a few days ago. . . . He said that the company had only money enough on hand to continue work for four months. The death rate among the laboring men had averaged 60 percent. Of 62 Frenchmen who went to the Isthmus from France one year ago, but 11 remain today. Forty-five died in that period, and six left on account of sickness. Mr. Boulange intends to remain in the United States. . . . Reports say that both the French and United States governments will be asked in turn to take up and carry out the project of a canal at Panama, but it is not likely that either will do so."

REPEATING RIFLE—"According to the semi-official *Berlingske Tidende,* the new repeating rifle of Captain Wadsen and Lieutenant Rasmussen is to be introduced in the Danish army. In this rifle the barrel is not fixed to the stock, but is secured by a spring. In firing, the barrel is forced backward, by which motion the bottom plate of the breech is opened, the empty cartridge ejected, and a fresh cartridge pushed forward into its place, the magazine holding six cartridges."

HIGH-SPEED PHOTOGRAPHY—"A photographer at Pesth has succeeded in taking photographs of projectiles, fired from a Werendler gun, while having a velocity of 1300 feet per second. The projectiles appeared on the impressions enveloped in a layer of air hyperbolic in form."

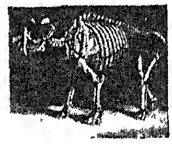
PATENTED—"In view of the fierce attacks sometimes made on valuable patents, it is well to remember that they represent a monopoly of but limited duration, and that their very value lies in the economy that they effect in some way for the people who use them. The use of a patented article is in every instance, we believe, a matter of deliberate choice as to a convenience, and not the resort to an absolute necessity."

STREET RAILWAY—"The longest street tramway in the world will be that which is to connect a number of towns near Buenos Ayres, South America, and which will have a total length of 200 miles."

EARTHQUAKE—"In a communication to the American Academy of Sciences, Captain C. E. Dutton gives a calculation of the depth of the Charleston earthquake centrum, which puts it at the enormous distance of twelve miles below the earth's surface."

STEAMER SPEED—"The *Queen Victoria,* the pioneer vessel of the new line intended to ply between Liverpool and the Isle of Man . . . sailed from the Tail of the Bank, Greenock, to Liverpool, in the remarkably short time of nine hours twenty-three minutes, representing an average speed of 22¼ knots, or 25.62 miles per hour."

DINOCERAS—"In 1870, while Prof. O. C. Marsh was making some explorations in central Wyoming, he discovered the remains of a huge animal whose form was entirely unknown to him, which he at once recognized as an extinct form, and which he named the dinoceras. His explorations in this region, at this time and subsequently, were extensive, and remains of different parts of this type were found from time to time, and the Peabody Museum at Yale College, over which Prof. Marsh presides, now contains specimens or portions of specimens of over 200 individuals, showing how common and abundant a type this must have been during a certain period of the earth's development."



AMERICA'S CUP—"The new British yacht *Thistle* . . . left for New York on July 25. She takes a crew of forty men. Her owner and her captain are sanguine that she will win the America's Cup. This vessel appears to have sailed faster than any yacht heretofore built in Great Britain. The new American yacht *Volunteer* will probably be the competitor of the *Thistle.*"

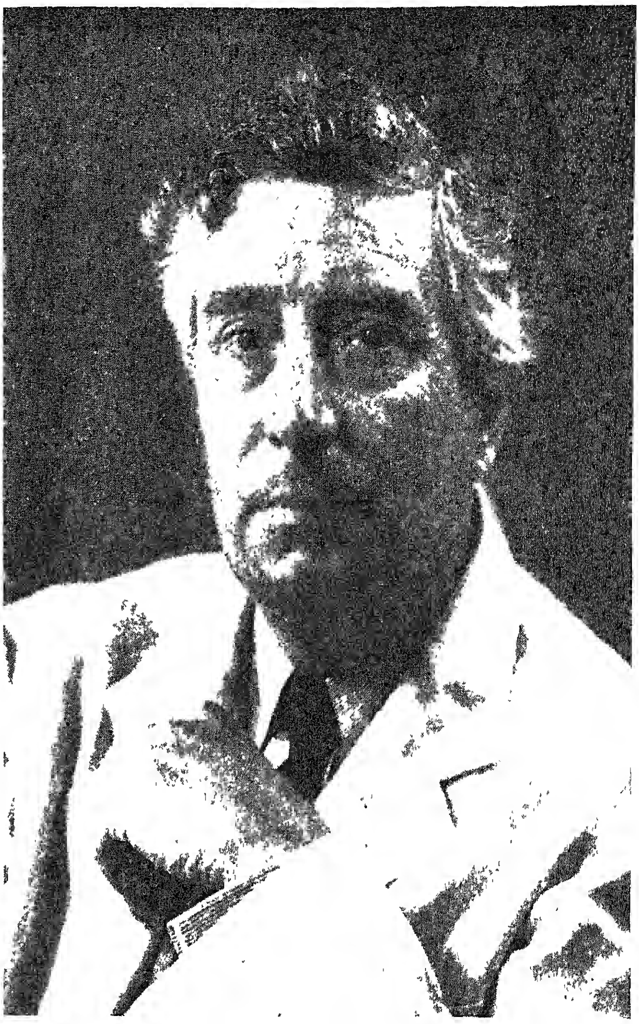
E. E.—"At a recent meeting of the Polytechnic Society of Berlin . . . the question was asked: What studies are best to fit one to be an electrical engineer? Herr Frischen, one of Siemens and Halske's experts, replied that much practical experience was required. After graduating from school, a rigid course in an advanced technical school should be taken, followed by an apprenticeship in a factory. He remarked that at present the title of electrician is used too freely, and that the claim of some to it is that they have nailed up a few wires."

WAR DOGS—"Among the thousand and one inventions, appliances and wonderful uses of men and beasts which German genius has devised to defeat France in case General Boulanger's successor becomes unpleasant, the dog plays a significant rôle."

### AND NOW FOR THE FUTURE

- Air Conditioning: Health, comfort, and industrial aspects of present and future research. By Brewster S. Beach
- Giant Molecules: The machinery of inheritance in its economic relationships. By Barclay Moon Newman
- All-American Canal: Engineering features of Southern California's newest water supply. By R. G. Skerrett
- Warship Changes: How the airplane has influenced design. By Dr. Oscar Parkes
- Kukulcan: New discoveries in a Mayan temple add to the sum total of archeological knowledge

# Personalities in Science



W. F. G. SWANN

BAD memory and a natural antipathy to physics and mathematics were boyhood characteristics of Dr. William Francis Gray Swann, director of the Bartol Research Foundation of The Franklin Institute, and associate editor of the *Journal of the Franklin Institute.* Today he is recognized as one of the most brilliant physicists in the world.

An informal "close-up" account of Dr. Swann's career is given in a recent number of *The Institute News,* published by the Franklin Institute, from which the following is taken:

Told, as a schoolboy, to memorize a proposition from Euclid, he felt unequal to the task and decided to bluff when called upon. At the close of his explanation the instructor announced that he had proved the proposition—and proved it correctly—only the solution wasn't Euclid's. After this, the boy solved all his problems the same way.

Born at Iron Bridge, Shropshire, England, the lad decided that he would study medicine, primarily because it was thought to be a profession in which it was possible to make a living. Prior to this time he had considered music as a career, but decided against it because it apparently held little prospect of affording a livelihood.

He substituted for a friend in a theater orchestra, playing the 'cello, thereby earning enough money to buy a microscope for his medical studies. The conductor wanted to discharge the regular 'cellist and retain his young deputy. Young Swann did not like that way of doing things, and did not intend making music his profession under any circumstances.

Browsing in an old bookshop, he found a very old volume which contained algebra, trigonometry, conic sections, differential calculus, the calculus of variations, the calculus of finite differences, mechanics, dynamics, hydrodynamics, astronomy, geodesy, and a few other scientific subjects—all for four cents.

That was the end of the medical career, which demanded that too many names be memorized, anyway.

There followed a scholarship to the Royal College of London, where he became a junior instructor after graduation. His research in physics attained wide recognition, and he accepted a lecturing position at the University of Sheffield. Here he also served as the very individualistic conductor of the university orchestra—on one occasion composing last-act music for a college play during the first intermission.

In 1915 the Carnegie Institution of Washington called Dr. Swann from Sheffield and he was made chief physicist of the Department of Terrestrial Magnetism. Asked to give a series of lectures at the United States Bureau of Standards, the talks to be held at eight o'clock in the morning, he protested that "an Englishman seldom stays up that late!"

In 1917 he was engaged as a consultant at the Bureau of Standards, and here again he became conductor of the orchestra, having a number of now world-famous physicists as his instrumentalists. In 1918 the University of Minnesota made him professor of physics. In 1922 he accepted a similar position at the University of Chicago, and in 1923 he went to Yale, where he was made director of the Sloane Laboratory.

In 1927 he was brought to Philadelphia to become director of the Bartol Research Foundation of The Franklin Institute.

His present investigations center principally around cosmic radiations, and he is also acknowledged as an authority in thermal measurements, electromagnetic theory, electroconductivity, relativity, terrestrial magnetism, atmospheric electricity, and atomic structure.

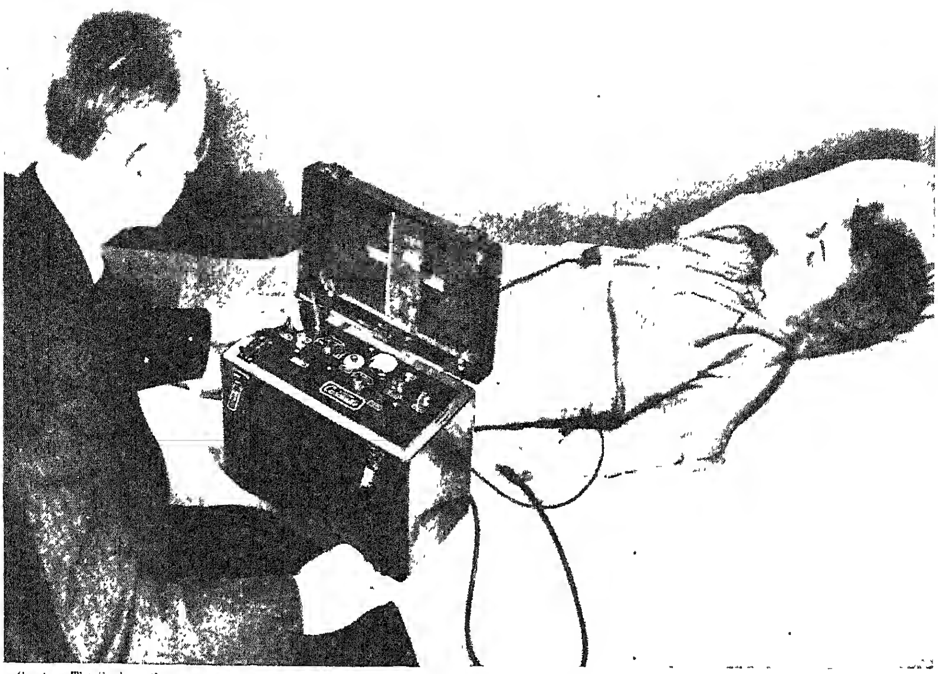
He has published innumerable research papers and several books, and is one of the contributors to the "Encyclopædia Britannica."

In his writing and his lecturing he has achieved exceptional fame because of his ability to make abstract theories comprehensible to the layman.

He is a member of learned societies here and abroad. Among other honors which have been showered upon him, he is past president of the American Physical Society.

A FAMILY OF GUEREZA MONKEYS FROM ETHIOPIA

SHUNNING cultivated areas and subsisting mainly on a diet of leaves with occasional additions of fruits and insects, the guereza monkeys of Ethiopia are the only African monkeys for the pelts of which there is a commercial demand. Their exceptionally long hair makes the skin suitable for trimming coats; it is used by natives for decorative purposes, and is also exported. Besides the black and white species shown above, there is also a red guereza monkey. The illustration shows a habitat group recently placed on exhibition in the Carl E. Akeley Memorial Hall of the Field Museum of Natural History, Chicago



Courtesy The Sanborn Company

The doctor brings a portable electrocardiograph to your bedside for a delicate heart test

# KNOWING *VS.* GUESSING IN MEDICINE

## Today the Physician Augments his Senses with a Multitude of Laboratory Tests . . . Microscopic, Electrocardiographic, and Many Other Tests

By MORRIS FISHBEIN, M.D.

Editor, *Journal of the American Medical Association*, and of *Hygeia*

THE family doctor of the horse-and-buggy era was largely dependent on his unaided five senses in making a medical examination. Solemnly he inspected your skin for eruptions, fingered your pulse, and peered into your throat or other body orifices. But the diagnosing of disease is no longer a matter of guess-work, based upon the observance of external symptoms. When you are ill today, your physician augments the testimony of his skilled senses by a multitude of laboratory tests which give him precise information about the nature and extent of your ailment. These tests enormously increase the accuracy of medical diagnosis, minimize the expense and duration of treatment, and always enhance the possibility of making a cure.

Many of these tests hinge upon ingenious devices that intensify and extend the doctor's faculties. Consider, for example, the sense of sight. With an array of "scopes," combining electricity, mirrors, and microscopic lenses, the modern doctor observes the remotest regions of your anatomy. The otoscope lays bare the ear drum; the long tube of the cystoscope lights up the interior of your bladder. By combining the gastroscope with an unbelievably small camera, the doctor can make photographs of the lining of your stomach wall and thus identify ulcers, tumors, or other changes. Guesswork is eliminated; the doctor *knows* the cause of your malady because, with these aids, he can actually see it.

The examination of tissue removed from the living body is one of the most crucial tests that the doctor makes. This scrutiny of living tissue—called a biopsy—is especially useful in determining whether or not a tumor is cancerous. Until recently, this test was a formidable operative procedure, but a new technique known as the "punch biopsy" is a vast improvement over the older method. In the punch biopsy, a hollow needle is inserted into the growth to be examined, and a cylinder of tissue is removed without disturbing the patient, or activating to further growth any existing tumor. A laboratory assistant then "freezes" this specimen, and with a miraculously sharp instrument called a microtome, cuts a transparent slice, fragile as a bee's wing. Delicately stained with chemicals, this slice is placed under a microscope; and the doctor's trained eye determines whether the tissue is of the malignant type associated with cancer.

In the detection of heart-disease, even the greatest specialist leans nowadays on the electrocardiogram—a graphic record of the changing electrical activity within the heart. As the heart contracts and dilates, five distinct "waves" of electrical energy, each having a special significance, are produced. These are traced by a complicated magnetic device on a reel of paper. By the arrange-

Medical Division, Eastman Kodak Company

**sized radiograph of young woman. Stomach and in-ies are outlined, due to eating an X-ray-opaque meal**

ment of these waves, the physician can detect disturbances of the heart long before they make themselves visible by the processes of ordinary examination. Such disorders as heart block, fluttering of the auricles, or an uncontrolled twitching of a portion of the heart muscle, write their own records in the electrocardiogram. By means of another testing machine called the sphygmograph, variations in the pulse beat are recorded on a moving strip of paper, a method far superior to the human finger in the accuracy of its measurements.

Grave conditions of the brain or spinal-cord formerly presented insuperable diagnostic problems; locked in the bony vault of the skull, the critical secret lay hidden from the doctor's eyes. Now, however, many of his questions are answered by numerous tests made upon the spinal fluid. To obtain a sample of this fluid, he inserts a hollow needle between the lower vertebrae; attached to this needle is a delicate gauge called a manometer, which registers the pressure of the fluid in the spinal canal. Any deviation from normal pressure suggests a disturbance of the brain or spinal cord. By the Queckenstedt test the doctor determines which *side* of the brain is involved. Using his thumb, he constricts the left side of the patient's neck, and observes (let us say) that the manometer registers a normal pressure. He then repeats the performance on the right side; if the spinal fluid pressure rises, that side of the brain is affected.

AFTER the fluid is withdrawn, some of it is smeared on a glass slide and examined microscopically for bacteria. Such examination may reveal cerebro-spinal malaria, spotted fever, or sleeping sickness. Early and effective therapy can be instituted in all of these diseases. Upon another portion of the fluid, a "white-cell" count is performed; large numbers of these cells may disclose infantile paralysis or epidemic meningitis. The *color* of the spinal fluid is also noted; normal fluid is as clear as distilled water, but a canary-yellow tint indicates a cerebral hemorrhage. If the fluid is cloudy it may mean active syphilis of the nervous system. Usually no clot forms in the spinal fluid, but in paresis many small clots appear, and in tuberculosis the clot has a web formation. A Wassermann or Kahn test on the spinal fluid helps to prove the presence of syphilis, while the colloidal gold test indicates the possible diagnosis of general paralysis, syphilis, or meningitis.

Possibly the physician decides that his patient has a tumor of the right hemisphere of the brain, yet is unable to localize the exact position of the lesion. To learn precisely where it lies he performs the following test: Into the same aperture from which the spinal fluid was drawn, air is introduced under gentle pressure, and rises through the spinal column to the brain. An X ray is then taken, and the tumor is clearly delineated on the X-ray plate.

In some illnesses, notably pneumonia and diphtheria, time is all-precious; early recognition enables the physician to take swift therapeutic steps. In treating lobar pneumonia, certain valuable serums are available, but before serum therapy is attempted, the physician must know what *type* of pneumonia confronts him. By the Neufeld test, several types of pneumonia may be differentiated. The patient's sputum is placed upon a slide; then a small amount of rabbit serum (obtained from an animal inoculated, for example, with Type 1 pneumonia germs) is added, and the mixture is stained with methylene blue. If the patient is suffering from Type 1 infection, the shell-like capsule enclosing the pneumonia germs swells visibly when viewed under the microscope.

Diphtheria can now be detected by the Brahdy "rapid culture test" in four hours. Using an applicator with a small knob of coagulated horse-serum at one end, the physician swabs the patient's throat, replaces the applicator in a sterile glass tube and—if laboratory facilities are not available—puts the tube in his vest pocket. The warmth of his body causes the micro-organisms of diphtheria, if present, to grow rapidly. He then rolls the swab over a glass slide, stains the smear, and makes a microscopic examination for diphtheria germs. If these are found, therapy begins then and there.

BY the Ascheim-Zondek test, the fact of pregnancy may be established within 24 hours. Almost immediately after conception takes place, certain hormone surpluses are produced in the blood and urine; if a small quantity of the urine is injected into a female mouse or rabbit, it stimulates their ovaries. They are then killed, their ovaries are examined, and if enlargement is observed, a diagnosis of pregnancy can be made.

It is one of the oddities of medicine that a similar test is useful in detecting teratoma of the male testicle. A teratoma

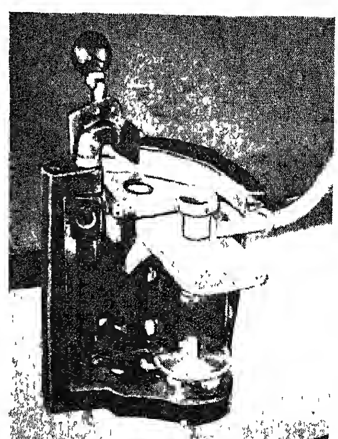


Photo American Medical Association

**A freezing microtome, a kind of glorified, delicate, exact meat slicer**

is a kind of cancer which may, at some stimulus, break into passionate growth, shooting its buds throughout the entire system and making castration imperative. This testicular freak creates a surplus of sex hormones in the male blood and urine. In 1933, Dr. Russell Ferguson of New York announced in the *American Journal of Cancer* that the hormone test for teratoma (based on the Ascheim-Zondek technique) was 98 percent positive, and that the tumor could be diagnosed within three weeks of its commencement.

A tremendous extension of the doctor's visual power is made possible by the X ray. When this device was first used in medicine, it showed only the shadowy outline of the bones; but constant improvements in X-ray technique now permit the doctor to vizualize the lungs, heart, kidneys, stomach, and intestines. The modern fluoroscope flashes on a white screen an actual moving-picture of your vital processes! When the doctor wishes to scrutinize your alimentary canal he gives you a glass of buttermilk containing a chemical which cannot be penetrated by X rays. You stand between the X-ray machine and a white screen; the current is switched on and the doctor notes the progress of the chemical mixture through your intestines. He pays particular attention to the shape and size of your stomach as it fills and empties, and thus detects the size and location of ulcers, cancer, or intestinal obstructions.

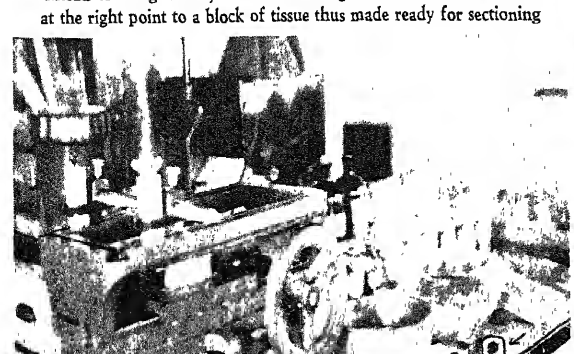
THE simple but dramatic Swick test is employed when a detailed examination of your kidneys is required. First a dye containing an iodine compound is injected into your arm; this dye enters the general circulation and is hurried to the kidneys for excretion. At precisely the right moment, an X-ray picture of the kidneys is taken, and these organs —filled with the opaque dye—are outlined with marvelous clarity. A few moments later, as the dye descends through the ureters to the bladder, another X ray is taken, and these narrow passages are clearly "spot lighted." Five minutes later, the bladder itself is filled with the dye, and a third X ray is made. By this test, the physician gets a complete story of kidney function and pathology.

About 40 percent of so-called "indigestion" is caused by some dysfunction of the gall bladder, a mysterious little sac attached to the wall of your liver. Often the shrewdest doctor cannot tell from your external symptoms whether you have gall-stones or an inflammation of the bile ducts. To rule out the possibility of gall-stones he orders radiographs. If no stones appear in your picture, you are given the Graham test. You drink a special dye which makes a determined effort to get into your gall bladder. If it does not, the physician interprets this failure in the light of his special knowledge. If, however, your gall bladder *does* fill with the dye, you are given a meal heavy in fat-content, and another radiograph is taken to see whether the gall bladder *empties* properly. After these tests are concluded, your physician presumably knows what to do about that excruciating pain in the upper right quadrant of your abdomen.

Before a surgeon performs an operation, he must know whether the kidneys are properly filtering the waste products of the body, for if these poisons accumulate, life is endangered. Kidney function is determined by several tests. A dye may be injected into the body and the rate of its excretion in the urine measured. By a complicated excursion into blood chemistry, the "urea nitrogen" test determines whether the amount of this element is normal or excessive. If excessive, the kidneys are not doing their necessary work, and the increased burden of an operation might easily be fatal.

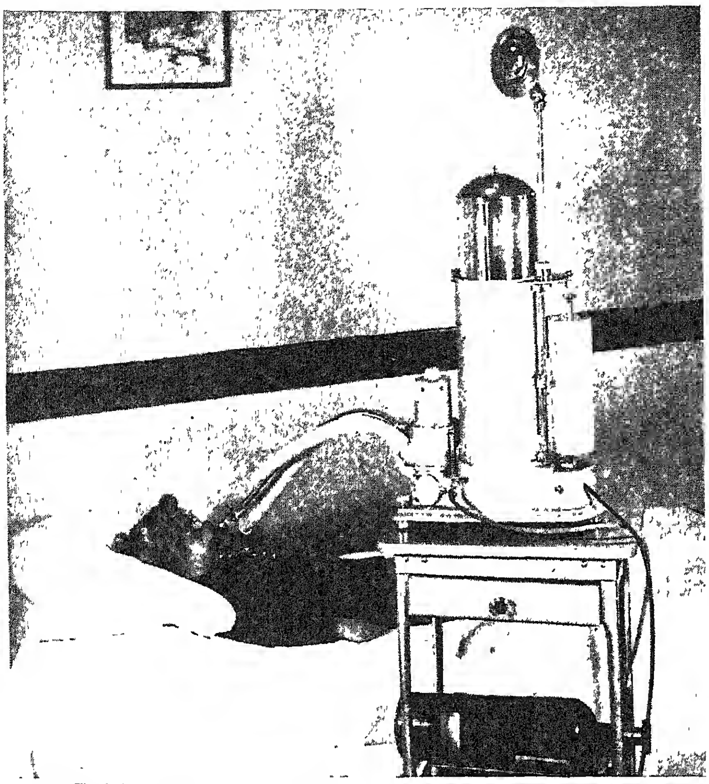
Blood tests are a fruitful

A paraffine microtome in which the tissue is infiltrated with paraffine instead of being frozen, before the slicing is done. Two little arrows at the right point to a block of tissue thus made ready for sectioning



Photos by Medical Division, Eastman Kodak Company

*Above:* X ray. The arrow indicates a cancer of th
*Below:* X ray of renal tract. Arrow indicates a s
cystoscope is clearly outlined in the bladder, low



Courtesy The Sanborn Company

*Making a metabolism test, to determine how much oxygen the patient burns*

field for diagnostic study. To examine your blood, the doctor punctures an ear or fingertip and withdraws a small amount. In cases of suspected anemia, he counts the red cells upon a hemocytometer—that is, a glass slide ruled into small squares. These red cells grow in the marrow of our large bones, and one of the latest blood tests consists in removing a small portion of marrow from a leg-bone to find out whether it is manufacturing cells satisfactorily. When the white blood cells multiply too rapidly, a serious condition called leukemia is the result; equally serious —and much more sudden as a cause of death—is the utter *disappearance* of the white cells.

BEFORE your physician pronounces a verdict of "appendicitis," he counts the number of white cells in a cubic millimeter of your blood. Why? Well, he knows that these white cells—the warriors of the blood-stream—increase rapidly in number when the body is combatting an infection. If this count is above normal, he checks with other symptoms and makes his diagnosis. Small greyish discs in the blood, called "platelets," are concerned with clotting; if there are more than 100,000 blood platelets in each cubic millimeter of blood we get along satisfactorily, but when the number falls below that amount we bruise and bleed easily. Blood chemistry has given medicine the "sugar tolerance" test, essential to the accurate diagnosis of diabetes, and the "hydrogen ion" concentration test to determine whether the blood tends toward acid or alkaline.

Sometimes, as a result of gall bladder disease, bile gets into the blood stream, and the characteristic yellow hue of jaundice is observed in the patient. To diagnose jaundice early, a device called a colorimeter is employed. Normal blood-serum is straw colored, but the serum of a jaundiced patient has an orange tinge. If this orange color deepens past a certain point on the carefully graduated scale of the colorimeter, the physician knows that his patient has jaundice, whether his skin is yellow or not. The value of this test, known as the Icterus Index, lies in the fact that it sometimes discloses obstructions of the bile ducts long before clinical signs appear.

When you are either nervous or sluggish, or show marked gain or loss in weight, the physician suspects thyroid disorder and decides to measure your basal metabolic rate. In plain language, he wishes to determine how much oxygen you are burning in a given length of time, under conditions of complete rest. A person undergoing this test reclines upon a sofa, the nose is pinched shut with a clip, and a tube is inserted into the mouth. Through this tube oxygen is breathed; the exhaled air passes into another tube where its carbon dioxide content is measured. After a few minutes, the test is stopped and another test is run as a check upon the first. Taking into consideration the patient's age, sex, weight, and other factors, the basal metabolic rate is determined, and the physician plans his therapy accordingly. Sometimes, as a result of this test, it is necessary to change the whole routine of the patient's life, or even to do an operation on the thyroid gland.

Chemical analysis of gastric juices is a vastly important test in determining whether a patient is suffering from ulcers or cancer of the stomach. In ulcers, an enormous rise of free hydrochloric acid is found in the stomach. But in certain malignant tumors, no acid can be found at all, because of the destruction of the acid-producing portion of the stomach wall. To determine the quantity of hydrochloric acid present, a test-meal of dry bread and weak tea is given the patient. He then swallows a thin rubber tube, and specimens of his gastric juices are withdrawn every few minutes and analyzed chemically for hydrochloric acid. When 10 or 12 specimens have been analyzed, a graph is then plotted showing the amount and rise of the acid content in response to food.

SUFFERERS from asthma or hay-fever are "allergic"; that is, excessively sensitive to some protein element in their diet or in the air surrounding them. Now these proteins are literally numberless, and range from grass pollen to fish-glue and face-powder. The task of the sensitization test is to discover the specific protein causing the trouble. Extracts of hundreds of these substances are now prepared by pharmaceutical houses; the doctor either makes a small scratch on your arm, or with a fine needle injects several extracts between the layers of the skin. An excessive redness or inflammation indicates that the patient is sensitive to a specific protein, and he then can be immunized against it.

A number of interesting tests are concerned with the diagnosis of infectious diseases and the ability of the human being to resist them. The Schick test is a measure of the body's ability to resist diphtheria; the tuberculin test indicates the susceptibility of a child to tuberculosis; and the Dick test estimates resistance to scarlet fever. If these tests show lack of resistance—indicated by redness or swelling at the site of injection—it is possible to inject toxin-antitoxin or other preparations that enable the patient to resist the disease.

These are but a handful of the tests the modern doctor invokes in diagnosing your malady. It is important to remember, of course, that none of these tests will ever wholly supplant the physician's skilled senses, nor would he dream of making a diagnosis solely upon the basis of a single test. The modern doctor correlates your symptoms, takes a careful history of your case, checks one test against another, and is thus liberated from the guesswork—often successful, but always hazardous—of the old-time practitioner.

# OUR POINT OF VIEW

## Yellow Jack Again

AN unknown villain has stalked forth from lush, reeking jungles to menace a world which had acquired a feeling of security, thanks to science, against the ravages of deadly yellow fever. The first villain, *Aedes ægypti*, the mosquito carrier of the disease—known in the early days as *Stegomyia*—had been so well put under control that everyone thought the end was in sight. A report of The Rockefeller Foundation indicates that a new start must now be made to identify the newcomer, an utter stranger as yet, and to find means of banning him from human society. At the outset the task promises to become a stupendous job.

To date many heroes and martyrs have left their marks on the hard, uphill highway toward eventual elimination of the disease. Longest in memory and perhaps most dramatic was the act of those soldiers who permitted themselves to be bitten by the suspected *Aedes ægypti*. The martyrdom of Noguchi, brilliant little Japanese of The Rockefeller Foundation, is fresh in the public mind, but the name Walter Reed awakens memories of tremendous gains in the fight near the turn of the century. Less well known to Americans are many others—among them Agramonte, Theiler, Lazear, Stokes, Finlay—who contributed enormously to the solution of the yellow-fever problem.

Before 1929, The Rockefeller Foundation believed that the disease was fast disappearing. Infected *Aedes ægypti* were becoming extinct—killed off at their breeding places by man's control measures. Consider Ecuador, for example. In that country since 1919, there have been no recognized cases of yellow fever, yet previously the yearly average in Guayaquil, alone, had been 259 cases! Indeed, as we knew it a few years ago, the disease *has* been brought under control.

"Jungle yellow fever," however, changes the picture. It occurs, according to the Foundation's report, "under conditions of rural or forest environment as distinguished from urban environment." Far from indicating that cities are immune, this actually provides a "source of virus for the re-infection of cities and towns where high densities of *Aedes ægypti* mosquitoes are tolerated." All the more imperative, therefore, is need for continued and intensive research to find the villain and control him if humanly possible. Fortunately, it is unnecessary now to experiment on human beings, for the Asiatic rhesus monkey can be infected. Moreover, a vaccine developed just a few years ago makes it possible for laboratory staffs to work in safety.

While awaiting the success that must eventually reward the scientists' efforts, action has been begun by health officers in the United States, in conference with the United States Public Health Service, to fight off the menace. They are concerned not with a flying mosquito but with a flying airplane, for the airplane has brought us dangerously close to yellow fever infected sections of South America. The Conference has suggested, therefore, certain restrictions as to the location of airports, eradication of *Aedes ægypti* from communities near airports, prevention of spreading of the disease after a single case is reported, and other control measures.

Because of the unknown factors involved and of the airplane, the further fight will enlist the co-operation of many outside the laboratory. But though the task is a big one, there is little question that it will be carried out to a successful conclusion. Happily, the further study will not be fraught with such danger as was faced by earlier researchers.

## Enforce the Law

MOTOR-VEHICLE accident prevention presents many ramifications and great is the number of solutions that have been offered. There are, however, so many phases of the problem that it splits into many separate problems, each of which must be considered not only as an entity but also in relationship to the whole. An interesting report recently received from the Northwestern University Traffic Survey Institute shows a definite and indisputable relationship between law enforcement and automobile accidents. By law enforcement is not meant mere arrest of motor vehicle law breakers, but actual convictions. To show dramatically the relationship between convictions and accidents, the Institute has set up an "Enforcement Index" which is obtained by establishing a ratio between convictions for violations of motor vehicle laws and the number of persons injured in accidents. If, for example, a city has 250 convictions for all types of violations during a period when 50 accidents have occurred, its "Enforcement Index" would be five. The average index for 78 cities analyzed by the Institute was 3.5; a good index rating is considered to be some 10 to 12.

The matter of convictions for motor vehicle law violators is one that cannot be too strongly stressed. "Killing of tickets," "knowing the judge," "having a friend at City Hall," all serve to make motorists less respectful of laws which have been set up for their own protection. If only every motorist knew definitely that a violation would bring swift and sure retribution, each driver would be more careful, would observe the laws, and accidents would undoubtedly be reduced. It is almost like grasping at a straw to hope that such can ever come to pass but if individuals will take more pride in a careful driving record than they do in the fact that they can escape conviction for a violation, if judges and justices of the peace will be more rigid in their law enforcement, and if arresting officers will take their jobs more seriously, it is possible to go a long way toward safer highways for a greater number of drivers.

## Take it Easy

WE hear a lot about cancer. We usually hear of heart disease only when someone whom we know dies as a result of it. Cancer is—and very rightly—being fought constantly with all the resources of medical science. Heart disease in its many forms is also given its share of attention but for some reason or other it does not seem to reach, in the minds of most people, the importance of the other dread disease. In view of this, it is interesting to cite a few figures. In 1933, heart diseases caused 286,360 deaths in the United States. In 1935, this figure had grown to 312,333. Cancer, during 1935, caused 144,065 deaths. And here is the peculiar thing about it: Generally speaking, cancer is a disease which is contracted through no fault of the sufferer—certain forms of industrial cancer excepted. On the other hand, heart disease can almost invariably be traced directly to the patient's mode of living. The high-speed life of the average American contributes largely to the prevalence of heart disease. Sane living, sane eating, sane drinking, and a more placid, slower speed of existence would go far toward reducing the ravages caused when the little pump so necessary to life goes awry. "Take it easy and live longer" may be trite but it is truer today than ever before.

# MORE GAME

## Game Birds Reared Under Artificial Conditions Can Survive in the Wild . . . A Foreigner Holds Promise . . . Sanctuaries . . . Future Shooting

By ANDREW R. BOONE

FORTY thousand quail and Chukar partridges—guinea pigs on the wing—inhabiting 38 mountain and desert game refuges in southern California are proving that game birds reared under artificial conditions can survive in the open and reproduce in large numbers to provide for sportsmen shooting in the future where today little or none is to be had.

In an experiment* which already has passed the bounds of a modest laboratory undertaking, the California Division of Fish and Game has released from its Los Serranos Game Farm at Chino during the last four seasons California Valley and Gambel's quail and Chukar partridges in numbers sufficient to provide good hunting by 1940.

Science and nature are combined in this large-scale undertaking. Twice each season, in October and January, workmen go into the Los Serranos rearing pens, snap onto frail legs metal bands (bearing serial numbers and a request that they be returned to the Fish and Game Commission with a report of where and when found or shot), transport the birds to various refuges, and there give them over to nature.

But this is neither the beginning nor the end of the story. For the beginning, we must go back some five years for a view of game bird scarcity in California's lush valleys and on barren mountains.

IN 1932, quail in California were becoming so depleted, due to inroads of hunters, natural enemies, and drouth, that sportsmen became alarmed lest they vanish completely. Two "cures" were proposed: restock with quail, or import some variety which would thrive at all altitudes, in heat and cold, in drouth and time of heavy rainfall.

Both ideas bore fruit. Chukar partridges were imported from India, quail were reared and planted. Where they should be released and how protected were early determined. August Bade, superintendent of game farms, drove home the need for outside holding pens. E. D. Platt, assistant superintendent, and others projected a plan for sanctuaries.

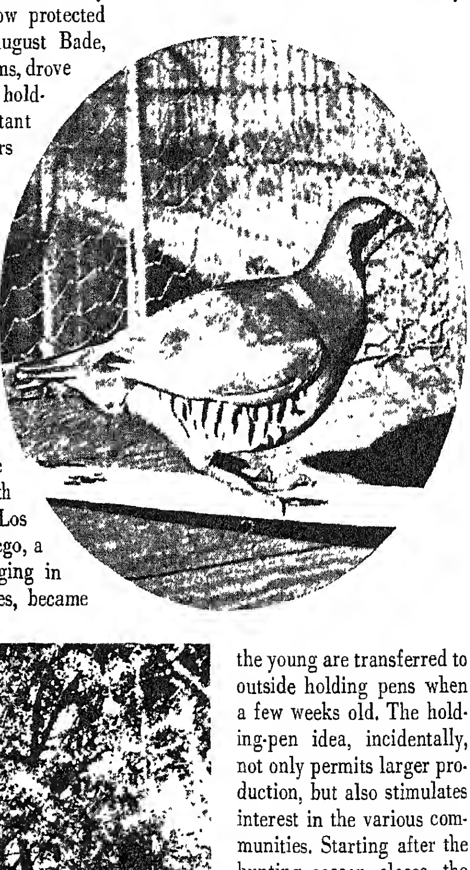
As the original stock of Chukars increased and were liberated from time to time, Platt pushed the quail conservation plan. Within three years 38 individual land owners "loaned" refuges to the Commission. Scattered in a 225-mile semi-circle from Sandberg on the north around the eastern edge of Los Angeles County to San Diego, a chain of sanctuaries, ranging in size from 640 to 5000 acres, became available as the natural laboratories where home-grown birds could test their mettle against nature.

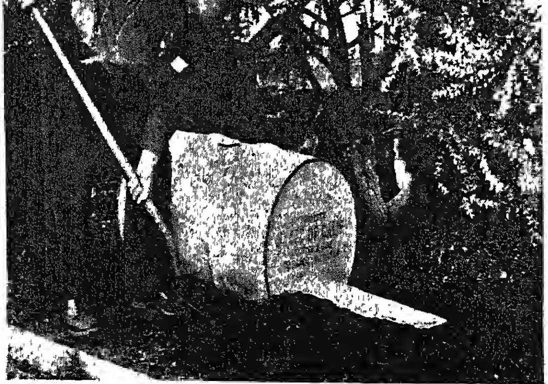
The movement grew rapidly and organizations all over the state took an interest in the program. Although not part of the immediate banding experiment, 700 outside holding pens have been constructed in northern California during the last two years. As a definite part of the banding program, 28 holding pens have been provided on private lands in the Chino farm district in the same period. Each pen is of standard dimensions, 24 feet by 24 feet, and holds 20 pheasants or 40 quail.

Now, here's how the scheme works; and it is bringing immense satisfaction to sportsmen, for it promises plenty of fine shooting by 1940 or thereabouts:

Quail are incubated and raised at the Los Serranos farm. Since more are reared than can be handled efficiently, the young are transferred to outside holding pens when a few weeks old. The holding-pen idea, incidentally, not only permits larger production, but also stimulates interest in the various communities. Starting after the hunting season closes, the birds are released on the refuges, thus permitting them to go into natural production the following spring.

Refuges may be anywhere, in valleys, on mountain slopes, near the desert. Platt is working toward the ideal of a large number of small refuges. In each case, the refuge must supply natural quail feed, in a combination of brush and open country. Where possible, water from native sources, preferably near the center



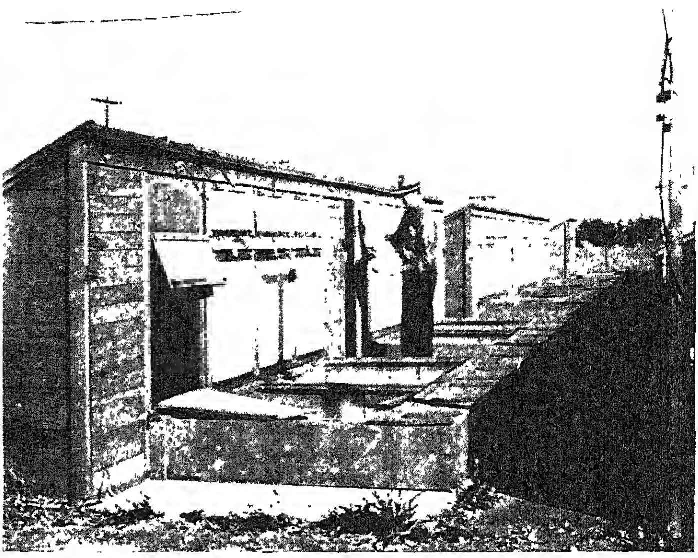


An artificial "spring" to provide water for birds where a natural supply is not available. *Circle:* Chukar partridge

*The work in California is typical of the conservation efforts being carried on by many other states.—*Editor.*

of the refuge, should be available.

In the absence of water, ingenious artificial "springs" are supplied. These are 55-gallon drums, fitted with long, shallow troughs into which the flow is controlled by an air pressure regulating pipe within the drum. In 12 of the 28 quail and Chukar refuges, artificial "springs" have been "planted." The trough, or pan, slopes inward toward the drum. Around its edges dirt is banked. Thus even the smallest birds may walk up for a drink, and step into the pan itself without danger of drowning. Caretakers service the "springs" every ten days, although it has been found that one will supply hundreds of birds and small animals for a month during hottest weather that would normally be encountered without replenishing.



The brood pens at Chino, California, where young quail and partridges get their start in life. *Circle, left:* Banding a California Valley quail

Observations on the various preserves reveal two important facts. Game-farm-reared birds thus far are doing at least reasonably well among those born and reared in the wild, and the stock is increasing.

Meanwhile, several questions puzzle authorities of the California Fish and Game Division. How long will game-farm-reared birds live under natural conditions? How rapidly will they reproduce? How far afield will they wander from the individual refuges? Can birds, accustomed during their first few months to being hand fed, forage successfully for themselves in the wild? How large should the sanctuaries be, how many are required, how should they be distributed geographically?

Answers to at least some of these questions already have been found, both as to quail and Chukars. Let's take quail first, both because the California Valley quail is California's natural bird, and sportsmen have not yet been permitted to try their skill on Chukars.

Platt, who supervises the brooding, banding, and release of both quail and Chukars from the Chino farm, and oversees the refuges in Southern California, told me that his patrolmen have found quail 20 miles distant from the point of liberation from 18 to 20 months later; on one occasion, quail had flown six miles during the first 24 hours.

Game-farm-reared quail survive thirst, drought, rodents, bob-cats, coyotes, and such birds of prey as the Cooper's, sharp-shinned and duck hawks (all of diurnal habits) just as well as those brooded in the wild. Census has been taken periodically at various refuges, and the proportion of banded birds to the known former population has remained constant, and in some cases increased. Since each hen rears to maturity in the wild an average of six quail, the 40,000 released to date are expected to provide fully 1,000,000 quail within four years, not counting the increase to follow the freeing of banded birds during that period.

ALTHOUGH 202,000 quail were reported killed in ten counties last season, this undoubtedly represents only a small part of the total. For 50 years California Valley quail have been making a gallant stand against human and other inroads. Shorter shooting seasons and restricted bag limits only served as stop-gaps. Now comes the policy of bird management, with refuges in four counties, placed strategically under a variety of local climatic conditions.

While the Chukar partridge has been released for four years, only during the last season were any liberated bearing bands. Little is known about Chukars by California sportsmen, yet they hope to be hunting them in a few years as the English do in its native land.

The Chukar (*Alectoric graece chukar*), introduced into California four years ago from Calcutta, is the Indian representative of a single species of partridge which contains 22 varieties, and which originally ranged from northern China to Mongolia, India, Persia, and Arabia to Asia Minor and Southern Europe.

With this bird the Fish and Game Commission hopes to provide both lowland and highland shooting, for the bird thrives at all altitudes from sea level to 16,000 feet, in countries with virtually no rainfall to those where 100 inches fall every year, in temperatures from nearly zero up to 150 degrees, Fahrenheit. Further, it can survive under conditions of humidity and heat which would discourage, if not obliterate, quail.

Chukars have been liberated in 26 counties in California since 1932. Heaviest plantings have been made in southern California, because in that region there is a vast area of arid land which is unoccupied by game species, and to which it is felt the Chukar will adapt itself.

They definitely are on the increase. Thirty-three Chukars were liberated in a remote section of the Mojave desert, and within three months dropped out of sight. Three years later 45 birds were counted within a few miles of the point of liberation. Some of these were definitely the young of the previous years.

California authorities give the birds every opportunity to increase. No shooting is permitted on the refuges, water is provided, predators of air and earth are shot and trapped. By thus restocking game-bird cover, officials think they will provide fine shooting within four more seasons, on lands of no value to farmers. And sportsmen are backing them wholeheartedly in the attempt.

# THE FUEL OF THE

## It is Now Believed that Hydrogen Transmuted into Heavier Elements is the Source of the Stupendous Energy that Keeps the Stars Shining for Eons

By HENRY NORRIS RUSSELL, Ph. D.

Chairman of the Department of Astronomy and Director of the Observatory at Princeton University. Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington. President of the American Astronomical Society

THE greater questions of science are not all insoluble: some of them have been pretty well answered in our day, and others are on the way to an answer. For example: Why do the stars shine? How long have they been shining? What keeps them shining so long?

The first question has been thoroughly answered. The stars shine because they are hot, outside; they are hot outside because they are very much hotter inside; and they are so hot inside because of their large masses.

Ever since Newton's days, it was known that the pressure in the interior of a body like the sun must be enormously great. As soon as the laws which govern the behavior of gases became known, it was easy to calculate that, if the stuff inside the sun followed these gas-laws, it would have to be at a temperature of many millions of degrees, if it was to stand this pressure without being compressed to more than the sun's density.

About 20 years ago Eddington completed the proof by showing that the battered fragments of atoms inside a star would indeed follow the familiar gas-laws very closely. Since then, no one has doubted that the temperatures inside the stars run up far into the millions of degrees. From these glowing regions heat inevitably leaks out toward the cooler superficial parts. The law of transfer of heat is also known, and hence the rate of supply of heat to the surface can be calculated. A body of large diameter will be cooler inside than a small one of the same mass; but heat leaks out more easily in the first case, and the whole outward flow turns out to be only a little greater for the smaller body. A large mass, however, must be hotter inside than a small mass of the same size; and here there is no compensating effect.

IT follows, therefore, that a large mass of matter (say enough to make a million planets like ours), isolated in space, *has* to be a star. It cannot help shining—the more strongly, the greater its mass. A small mass (say less than 10,000 times the earth's) *cannot* be a star; not enough heat can escape from the inside to keep the surface luminous.

So far, so good; but a large mass cannot be a star forever; it is sending out enormous floods of energy into space, and it must get this energy from some source, which must inevitably be finite in amount. In the long enough run, therefore, a star must run down—something must happen to it—while there is, of course, no limit which our present knowledge can set to the time during which a smaller solid body, like the moon, or a meteoric stone, would continue an unchanged and uneventful existence.

One source of energy, at least, every star must have. Contraction, under its own attraction for itself, can liberate gravitational energy, turn this into heat, and keep the star shining. If the sun, for example, had contracted from a large size to its present dimensions, it would have gained enough heat to maintain about 20,000,000 years' radiation at its present rate. At least half of this supply must still be stored up in the sun's interior; but, even so, human history is too short to detect a change.

Geological time is another thing entirely. We know from radio-active evidence that some rocks are at least 1,500,000,000 years old, and there is strong evidence that the sun has kept the earth at very nearly the same temperature as now for all that interval. That is, the sun has radiated into space something like 100 times more energy than its past gravitational store, or its present internal heat content, could have supplied.

Now the sun is a very ordinary sort of star, with no peculiarities, and no one doubts that the other stars, too, have got rid of far more heat than can be accounted for gravitationally. Here we must fall back on Einstein's principle that energy and mass are equivalent. A simple calculation shows that the energy radiated by the sun every second diminishes its mass by 4,200,000 (metric) tons. Multiply this by the number of seconds in 1,500,000,000 years, and we get 1/10,000 of the sun's whole mass!

If, then, something happens inside the sun, by which even a small part of its mass disappears, and the corresponding amount of energy is liberated, it may keep on shining for much more than the past length of geological time.

Students of the subject have agreed, for a good many years, that this must be the explanation, and two possibilities were discussed; first, atoms may disappear altogether, and corresponding amounts of energy take their place: second, heavy atoms may be built up out of light ones, and, in particular, out of hydrogen. Why hydrogen? Because hydrogen atoms are heavier in proportion than any others. It is now a familiar idea that four hydrogen atoms might be taken apart, and the four heavy positive nuclei (protons) and two of the electrons lumped together into a single helium nucleus, leaving the other two electrons to make the outer part of the atom. But the mass of a helium nucleus (which can now be measured with extreme precision) is 4.0039 standard units of atomic weight, while that of a proton is 1.0081 such units. If one could be built up out of four of the others, 0.0285 units of mass, or 1/140 of the whole (not counting the small masses of the two electrons), would have to vanish—and appear as energy. If the sun were originally composed of hydrogen, and could turn into helium, the energy liberated would be enough to keep it shining, at its present rate, for more than 100,000,000,000 years. The formation of heavier elements out of hydrogen would liberate a little more energy, but not much—it is the first step which counts. The greatest effect would come from the formation of atoms of iron and similar elements. The largest atoms, like uranium, are heavier in proportion, and so can unload energy by radio-activity. But this supply, huge by any ordinary standards, is small in comparison with that of formation from hydrogen.

A DOZEN years ago, both of these possibilities were purely hypothetical. One of them remains so. Not the slightest evidence has yet been found that it is possible for an atom to be

# STARS

*annihilated*, and its whole mass to appear as energy. But, in the last few years, an extraordinary variety of processes has actually been realized, by laboratory experiments, in which *transmutation* of hydrogen into other elements occurs. For example, a lithium nucleus (charge 3, mass 7.0180) struck by a proton (charge 1, mass 1.0081) produces something which instantly breaks up into two alpha particles, or helium nuclei. These have each a charge of 2, and a mass 4.0039, so that 0.0185 units of mass disappear in the reaction. The alpha particles—whose tracks have been observed—fly apart with enormous velocity, and the energy of this motion exactly accounts for the loss of mass. There can be no more doubt, then, that hydrogen is not only "the raw material of the universe"—as Eddington called it years ago—but the fuel of the stars, which keep shining by building up heavier atoms out of it.

BUT here an alarming question arises. What keeps this process, with its terrific potentialities, under control? What prevents its ending in explosions of unimaginable violence?

Fortunately for the stability of the universe, the process of transmutation does not go on automatically. A hydrogen atom and a lithium atom, at rest side by side, can remain at peace indefinitely. Even if they were jostled about by thermal motions in the gas hard enough to knock off the outer electrons, and strip both atoms to the bare nuclei, nothing more would happen; for the nuclei themselves both have positive charges and repel one another strongly. They do not get close enough together to make trouble. It is only when the protons are shot at the lithium atoms with very high speed that one in 100,000 or so of them escapes from lateral deflections, makes a direct hit on the lithium atom, and gets by the barrier of repulsion, so that at last the two nuclei coalesce.

Atomic collisions of equal violence will occur in a heated gas only if the temperature is measured in tens of millions of degrees. The insides of the stars, so far as we can calculate, are just hot enough to permit such atomic encounters to occur occasionally, and the supply of heat from transmutation will be gradual. Nevertheless—suppose it was more rapid than could be carried off by leakage to the surface. We might expect the inside of the star to get hotter. Atomic collisions would then be more violent; transmutations would happen oftener; heat would be developed still faster, and an explosion would not be long delayed.

Gravitation saves the situation this time, by a reversal of the contraction process already described. If the star contracts, at least half of the gravitational energy must be expended in heating the gases of the interior; only the remainder is available to keep it shining. It loses heat into space, but gets hotter inside—both stores of heat coming from the contraction. Conversely, to put heat into the star forces it to expand and to put so much energy back into the gravitational store that the interior grows cooler. This tends to shut off the supply of heat from atomic interactions, and the star is thus self-regulating. After some possible initial oscillation, it will settle down into a steady state in which just enough heat is produced from the atoms to balance the leakage to the surface, and in such a state it may remain for a very long time.

In the course of ages, the hydrogen would be gradually exhausted, and at long last the star would contract until it could contract no farther, and become a white dwarf like the companion of Sirius. But the sun appears to have traversed hardly a hundredth part of this long road during geological time.

ATOMS with small nuclear charges, such as lithium and beryllium, would be very susceptible to transmutation, and these elements are very rare in the sun. Helium, which has a still smaller charge, is abundant; but this is probably because some of the transmutations, instead of building up heavier atoms, result in a breakdown into two or three helium nuclei. With larger nuclear charges, as for oxygen or neon, the repulsion of the proton is so great that at stellar temperatures it should hardly ever score a hit on the nucleus. Atkinson and Houtermans calculate that, inside the sun, a lithium atom would, on the average, suffer transmutation in a minute, while one of neon would last for a billion years. Weizsäcker, in a recent and interesting discussion, points out that we now know almost enough of the properties of the lighter atomic nuclei to follow the process of transmutation in detail. Only one step is lacking. Nuclei of mass 5—which should be isotopes of helium or lithium—have not yet been detected in the laboratory. When once these have been observed, and their masses exactly measured, it will be possible to work out the way in which they can be built up, or will break down, and deduce the whole story.

But there are many heavy atoms in the stars, with nuclear charges so great that a proton has no chance at all of disturbing them. To build these up requires heavy particles without charge—that is, neutrons.

Once again, we know that such things are possible. The last few years have shown that almost any heavy atom, struck fairly by a neutron, may be changed into something else. We can detect these artificially produced atoms when they are unstable and radio-active—and they change into stable ones, heavier than the originals. Great amounts of energy are liberated in these reactions, for a neutron is slightly heavier than a proton, and its "packing" into a heavier atom leads to a decrease of mass.

THESE reactions happen so easily that, if there were originally a host of neutrons inside a star, they would all be captured by heavy atoms in a few seconds. To provide a steadily operating process, neutrons must be continually produced from the lighter elements, and as regularly taken up by the heavy ones.

Weizsäcker gives reasons for believing that, among the types of unstable nuclei which may be built up from protons and light atoms, some will break up with the liberation of deuterons (nuclei of heavy hydrogen); and it is known that deuterons may break up into protons and neutrons. It is probable that a sufficient number of neutrons will thus be produced to permit the gradual formation, step by step, of the heavy atoms.

All these extraordinary things should happen only in the very core of the star, a small, exceedingly hot region. The gas in this region would be so much heated that it would rise toward the surface—other material descending to replace it. The resulting circulation should keep the star stirred up, so that its whole material was gradually transformed.

These conclusions are still tentative—though founded in general on a sound physical basis. They lead to interesting conclusions regarding the history of a star. For example, as the amount of heavy elements, formed from hydrogen, increases, the chances of collision between protons and heavy atoms increase. Hence, a lower temperature would suffice to provide enough transmutations to keep the star shining, and, as a star grows older, it should at first slowly expand.

In a few years more, if nuclear physics advances as it has been doing, we may at last have a reasonable basis for working out the history of a star.—*Mt. Wilson Observatory, April 22, 1937.*

# More Horses in the Air

## A 50-Fold Increase in Airplane Engine Power Within 34 Years . . . Basic Advances . . . Skill in Design and Research . . . End Not Yet in Sight

By REGINALD M. CLEVELAND

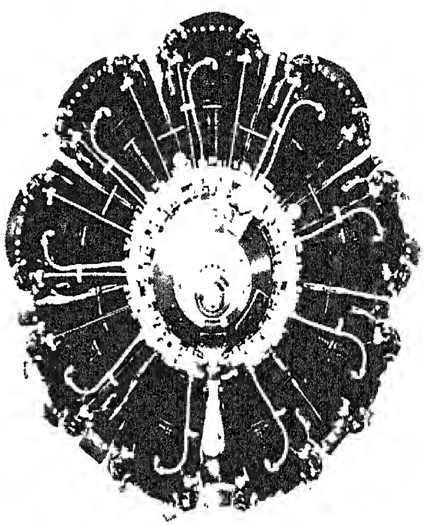
WHEN, in December, 1903, Orville and Wilbur Wright made the flight which ushered in the Air Age, their flimsy biplane was powered by a home-made engine of 30 horsepower. In less than 34 years, the genius of the engine builder has multiplied this power 50-fold and at the same time has so enormously improved the reliability, the smoothness, and the all-around performance of the aircraft engine that it would indeed be difficult to recognize it as something akin to that which made history at Kitty Hawk.

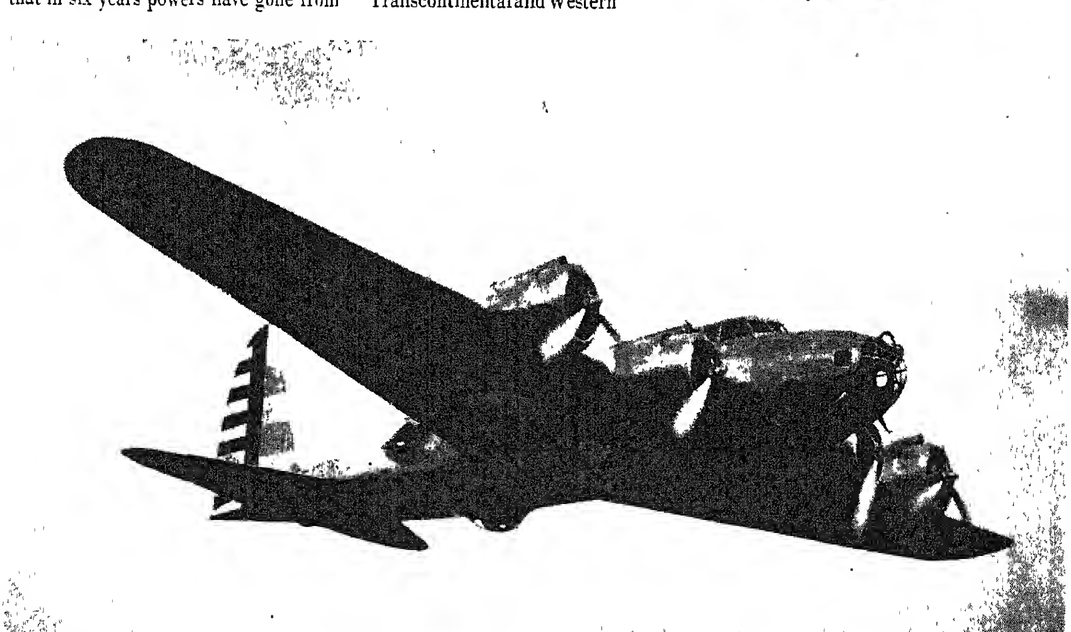
While every acknowledgment must and should be made to the skill of the aircraft designer and to those more obscure skills which lie in the efforts of the research engineer in aerodynamics, it can fairly be said that none of the remarkable performance of speed and load and range which characterizes aviation today would have been even remotely approached if it were not for the basic advances which have been made in power plants.

So startling, even to the men who live with them, have been the recent gains in horsepower of the larger air-cooled radial engines made in the United States that definite predictions of limits cannot be obtained even from responsible heads of engine companies. Guy W. Vaughan, president of the Curtiss-Wright Corporation, has recently declared that it is impossible to say what maximum horsepowers will be attained. He pointed out that in six years powers have gone from 600 to 1500 and that a limit could not be fixed. The engine division of the United Aircraft Corporation holds that take-off horsepowers of from 1500 to 1800 seem feasible in the period immediately ahead and that, in the not too distant future, take-off powers of from 2000 to 2500 horsepower could be made available if airplane development requires them.

Indeed, engines with horsepowers of the order of the lower of these figures are in existence. A few details were recently released on the largest production aircraft engine in the world. This is the Wright Cyclone R-2600, a 14-cylinder, twin-row engine of new design, developing 1500 horsepower. Although the Navy has purchased only one, and the Army two, of these new engines, while Pan American Airways has purchased 26 for their new three-decker 72-passenger Boeing trans-atlantic flying boats and Transcontinental and Western Air has purchased 32 of them, the fact that the services are using the engine still keeps many of its details secret. The cost of the engine to commercial users is estimated to be 13,500 dollars each.

It is also known that the Pratt & Whitney Aircraft Corporation, which has long been an advocate of the twin-row

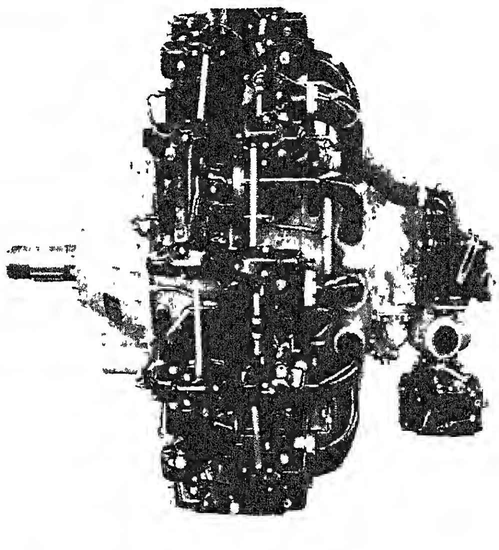




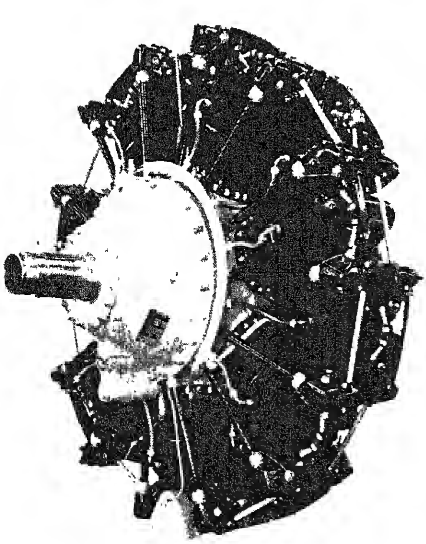
A fleet of 13 of these Boeing bombers is being produced for the United States Army Air Corps. Ranked as the fastest bombing planes in the world, they are powered by 1000-horsepower Wright "G" Cyclones. One of the engines is shown at right above

Equipped with Pratt and Whitney Twin Wasps, this Navy Consolidated Patrol Boat is one of 172 that have been ordered

type of air-cooled engine, has power plants of a similar power rating ready. Wright Cyclones of the 9-cylinder, single-row type, developing 1220 horsepower as an emergency rating—the most powerful motors of their type in the world—will be used on the four-engine Boeing land planes of Transcontinental and Western Air, and Pratt & Whitney twin-row Wasp engines of more than 1200 horsepower are expected to be mounted in the Douglas DC-3 sleeper planes which will be delivered to United Air Lines by the time this article sees the light of day.



This enormous development in available horsepower in air-cooled radial engines has been the result of a long series of technical improvements involving design, metallurgy, super-charging and, above all, cooling. There has been a cumulative effect from the combined research of the National Advisory Committee for Aeronautics, other technical laboratories, and the engineering staffs of the engine builders themselves. This has served to increase the pace at which power, dependability, and economy of fuel could all be increased, so that the gains in the last year have been far more spectacular than in the two previous years, while those of the past three years have far outstripped those of the preceding five. One hesitates indeed to set a limit, in view of this accelerated rate of improvement and that what seemed impossible half a decade ago is today an accomplished fact.



*Above and in center of page:* Three-quarter and side views of the efficient Twin Wasp engine in which 14 cylinders are arranged in two staggered rows around the central crankcase, as best shown in the center photograph

Not only have the engines themselves been so greatly improved as to be almost unrecognizable, but development has kept pace in at least three correlative fields to make available to the full the improvement in the power plants.

Even the astonishingly fine radials of today could not perform as they do for both military and commercial aircraft and could not make possible the astonishing performance of American domestic and international airlines were it not for the strides which have been made in propeller design.

The variable-pitch propeller and its younger brother, the constant-speed propeller, have implemented the modern engine of whatever type, so that it is now equipped with an automatic gear shift, adapting it to the highly variable conditions of altitude and load under which it must perform, and enabling it to operate with equal satisfaction for takeoff, climb, and cruising conditions. The Hamilton Standard constant-speed propeller assuredly has been one of the major contributions to air progress of the last few years. Another constant-speed unit, the Curtiss electrically controlled feathering propeller of more recent introduction, also bids fair to play an important rôle in this field.

Associated with propeller development has been the important study of vibration in both engine and propeller. For a time, a few years ago, a number of serious accidents in both military and commercial flying were attributed directly to propeller failures. Now a propeller

failure is almost unheard of, and instances like that untoward one which nearly cost the life of the famous designer of racing planes, Ben O. Howard, and his wife in the Bendix Transcontinental Race of last year, when a blade flew off, are so rare as to be exceptions which more than prove the rule.

The cure for propeller failures was composed of a number of elements but the most important was certainly the study of vibration made by the N.A.C.A. and the National Bureau of Standards. This exposed the astonishing fact that harmonics of vibration were set up in certain cases between parts of the engine, such as the crankshaft, and parts of the propeller, such as the hub, causing, when the note of what might in truth be called the "dance macabre" was reached, the flaw which led to failure. The cure was then comparatively simple. The vibration frequency in the two parts was merely kept out of tune.

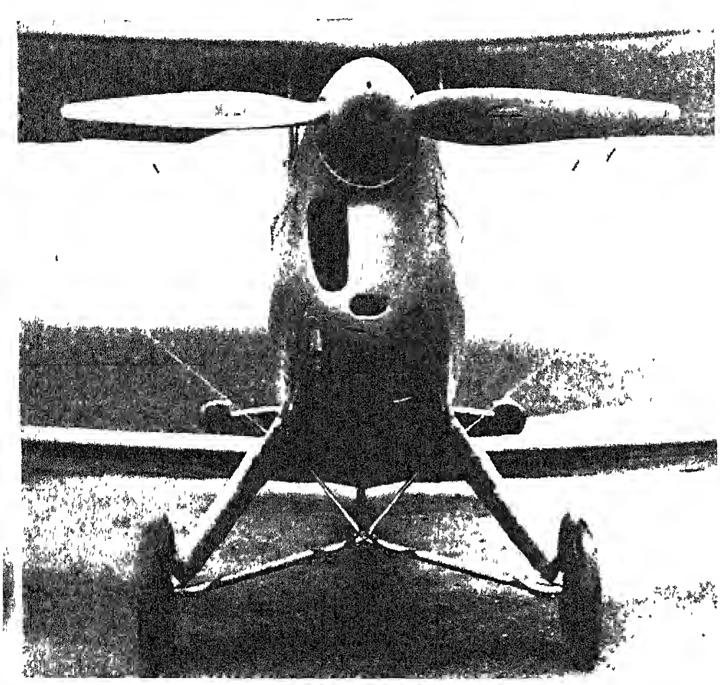
Vibration in the engine itself has also been greatly lessened by recent developments. Rubber shock mountings are now general practice. Torsional vibration, present to some degree in all conventional aircraft engines, and destructive critical torsional periods which have made their appearance in rigid crankshaft systems, have been eliminated by the introduction of the dynamic damper.

This device, developed by the Wright Aeronautical Corporation, for which E. S. Taylor, now of the Massachusetts Institute of Technology, received this year the Sylvanus Albert Reed award, is in principle a pendulum counterweight which is mounted on the crankshaft in place of the conventional, rigidly-mounted counterweight, the pendulous mass being free to oscillate in a restricted arc and in the plane of rotation. When disturbed, the restoring force and the frequency of the given pendulum, which is so mounted, is determined by the acceleration due to the centrifugal force of rotation of the weight. The magnitude of the acceleration is in turn determined by the speed of the rotation of the crankshaft.

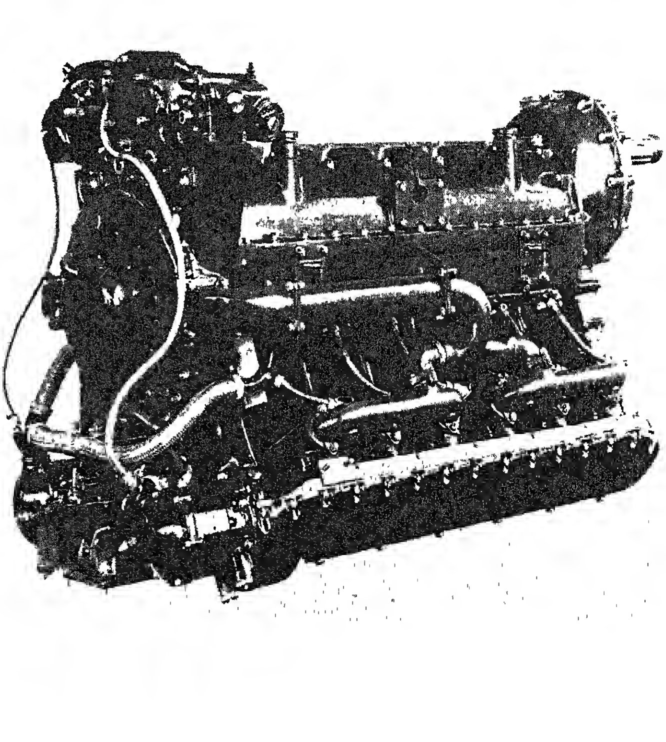
In operation, the pendulous weight is of such dimensions and so mounted that it oscillates at explosion frequency, but out of phase with the explosion impulses. It thus applies a counter-torque to the crankshaft which balances out the periodic torque fluctuations arising from the explosion impulses. The dynamic damper dissipates essentially no energy by friction. It acts by introducing a balancing force which is opposite in direction and equal in magnitude to the disturbance force at all speeds.

The third correlative development which has helped to bring power plants to their present high state has been in fuels. The contribution of the oil industry to aircraft fuel improvement also has been of a cumulative character and has gained impetus with each succeeding year. It was only two years ago when the Army, through the Matériel Division of the Air Corps at Wright Field, made the first flight tests of fuel of 100 octane rating. This high anti-knock rating provides an increase of approximately 30 percent in the horsepower of a given engine. Development has not stopped at 100 octane rating, however, and fuels of an anti-knock rating considerably higher than this arbitrary figure have already been produced and can now be produced in commercial quantities from what have hitherto been waste by-products in refinery practice. The latest development in this field was the announcement at the last annual meeting of the Institute of the Aeronautical Sciences, by Major E. E. Aldrin of the Stenavo Specification Board, that "safety fuel" of 100 octane rating was now in sight.

TWO factors in the development of high horsepower spark-ignition engines have led to a situation in which it becomes doubtful, to say the least, whether oil-burning engine development will be carried in this country to a point where it will become a serious contender for aircraft. The first of these factors is that of the just described improvement of fuels for spark-ignition engines. Should the so-called "safety fuel," or gasoline of a very high flash point, become commercially available in anti-knock ratings of 100 or better, the safety



*Above:* A Focke-Wulf powered with a Menasco inverted engine of 150 horsepower. *Below:* Three-quarter view of the Ranger inverted air-cooled engine

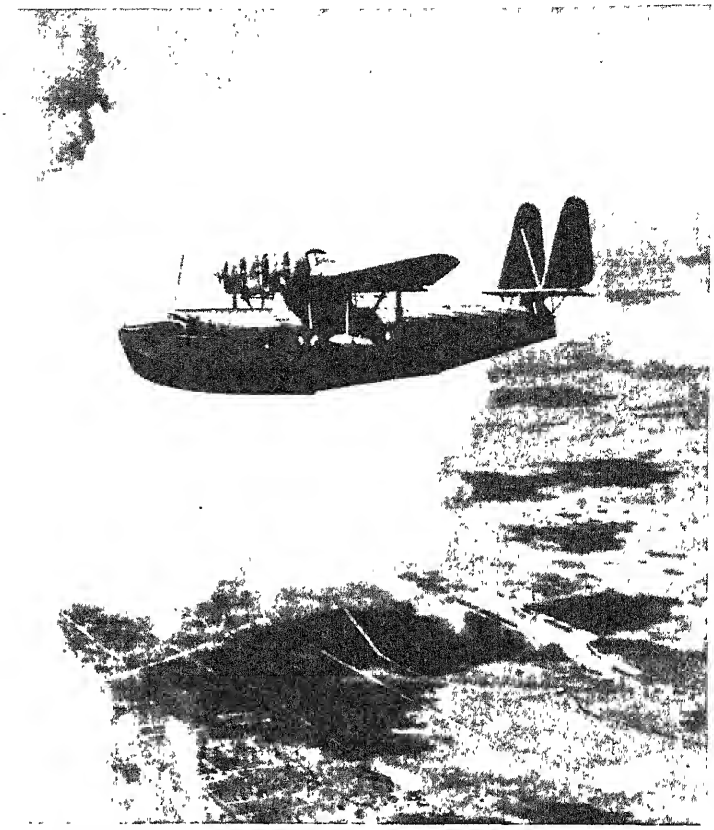


argument for the heavy oil engine would be nullified.

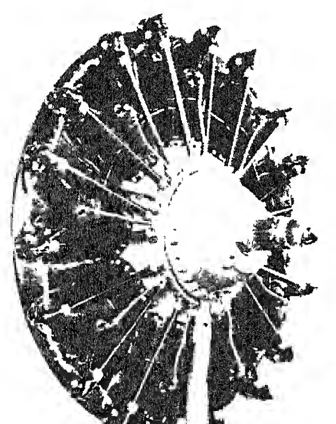
The second factor has been the improvement in fuel economy of the gas engines themselves. Whereas, only a year or two ago, gasoline consumption of the order of .55 to .60 pounds per brake horsepower per hour was the rule, as contrasted to Diesel consumption of .35 to .45 pounds, today gasoline engines on the block have shown consumptions below .40 pounds and it is freely predicted that .37 or .36 will be reached.

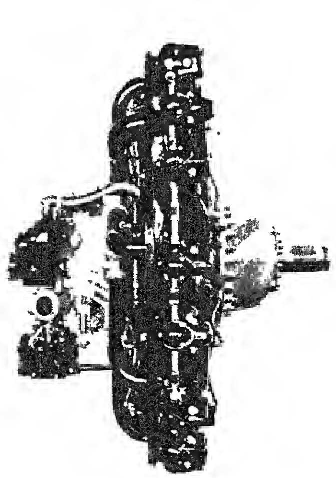
Then too there seems every probability that the advantage of the cheapness of fuel which now lies with the Diesel would be largely lost as soon as the demands for Diesel fuel became more general and as soon as it was widely taxed. While it is true that recent Diesel developments, especially in Germany and France, have reduced the weight disadvantages of the oil-burning engine as compared with the gasoline engine, this handicap has by no means been overcome, and it seems improbable, because of the necessary pressures, that the Diesel can be brought to the very low weight per horsepower now shown by the large radial air-cooled engines, which is below 1.25 pounds.

Engine development, however, has not been confined to the large size radials suitable for the large flying boats and giant land planes which already fly the airlines and give striking power to the services, or the still larger ones in the offing. There has been steady development also in in-line, air-cooled engines. The Ranger engine, built by the Fairchild Aircraft Corporation, has already received an approved type certificate for powers up to 600 horsepower. A development is now in process which will put two of these six-cylinder engines together in the form of an H. There is much interest in this thought, both for military and commercial practice. For pursuit ship use, the H engine permits the introduction of a large caliber airplane cannon which will fire through the crankshaft, thus obviating the necessity of synchronization with the propeller.



*Above:* Sikorsky Clipper Ship built for Pan American Airways. It is equipped with constant-speed propellers and Hornet engines, two views of which are at left and below





For transport use, the in-line engine, either in its simple form in smaller sizes or in the H form, presents a smaller frontal area than the radial of comparable power and offers less drag.

Notable development has also been made in the Menasco in-line engines, which have made such a good name for themselves in racing airplanes. Engines of this make have recently been purchased by the Bellanca Company to power five-place private planes designed to cruise at 200 miles an hour on 220 horsepower.

For the private flier desiring to use the smaller airplanes which are aimed at a market within the class of a moderate price automobile, there have been a number of interesting engine developments. Notably, the automobile engine has invaded this field. In the Arrow sport plane, the Ford V-8 motor is used with success. Another of the private airplanes uses the Plymouth engine, and an amphibian now under development by Charles S. (Casey) Jones makes use of a Terraplane engine with propeller driven through six V belts.

SMALL sizes in radials and in-line engines in the low price, private-plane field have also stepped ahead within the last year in quality and performance to a remarkable degree. The largest single commercial engine order, in point of numbers, ever placed was that by the Taylor Cub manufacturers for 1050 Continental 40-horsepower engines.

All along the line, therefore, of engine development the United States is striding ahead. All along, that is, except in the field of the liquid-cooled engine which many experts believe should not be dropped in view of the high-altitude operation which seems to be ahead, and in view of certain advantages of streamlining which cannot be obtained in the air-cooled engine and certainly not in the radial type.

Last-minute news, as this article goes to press, tells of an interesting development in the liquid-cooled engine field. The Air Corps has just issued an approved type certificate for the Allison liquid-cooled V-12 engine of 1000 horsepower, weighing 1275 pounds.

# RADIUM—

# NATURE'S ODDEST CHILD

## Becquerel Passed Up the Chance to Discover Radium . . . Nobody Knew Marie Sklodovska . . . Few Knew Marie Curie . . . She Held Out

By JOHN A. MALONEY
The Museum of Science and Industry, Chicago

*(In Four Parts—Part 1)*

RADIUM! Forty years ago that word would have meant nothing, whether it was shouted from the housetops or broadcast in the press of the world. Today it is the magic cry that may arise from the burning sands of Colorado, from the stagnant lands of the Belgian Congo or from the frozen shores of northernmost Canada. Today it comes laden with meaning, for it conjures up in the minds of bed-ridden cancer victims a glimmer of hope for a new lease on life that no other word can bring. In the minds of the prospector, the engineering chemist and the miner it denotes months of toil, and in those physical laboratories of the world that will be fortunate enough to receive even the smallest share of it, the announcement of the discovery of radium-bearing ore renews the interest of the staff in the research that is making of radium one of the greatest tools of this scientific age.

Of all the substances known to man, radium is the most costly and precious. The very mention of its name creates an air of mystery and value. Gold? Gold fades into insignificance by comparison. Gold is worth about 35 dollars an ounce, while radium, if it were possible to buy an ounce, would cost about 1,500,000 dollars. Radium has been selling in the world market for about 70,000 dollars a gram, and a United States one cent piece weighs about four grams!

Of all the building blocks or elements of this old world of ours, none present such difficulties to the men who attempt to wrest them from the clutch of nature as radium. It is a substance that can best be described by the word "odd." Radium stumbled on the cosmic stage 39 years ago in an odd way. Its behavior is so odd that it sets it apart from other elements in a most emphatic way. Secured by man after much labor, it passes through a very long life and performs one of the oddest feats that an element could perform, namely, the transmutation of itself into another element—lead. The results of its most ordinary and prosaic uses are replete with the oddest kind of contradictions. And last but not least, men in general have formed some odd ideas about it, with the result that many popular conceptions about radium strike the man schooled in its properties and uses as very, very odd.

In the following we will set down the simple story of radium—a story so full of startling happenings in the discovery of the element itself, in its properties, in its man-made history of less than half a century, and in its future possibilities

Radiograph of a key, taken with a rich piece of carnotite, an ore of radium. This is about what happened in Becquerel's laboratory

through that ever-changing science of modern physics, that if its simple narration will afford a brief and pleasant venture into a field that is as yet untrodden by the layman, we will have achieved our purpose.

Let us begin to trace the life and works of radium by projecting ourselves in imagination back into the year 1895 A.D. We find ourselves in a scientific world that smacks of smug complacency. The electric light, the telephone, the telegraph, and a score of other inventions of this busy period have been in use long enough to prove to mankind in general that the subjects of physics and chemistry are, after all, capable of producing things that can be used in a workaday world and of making it a better place in which to live. The scientist, himself, is coming to be regarded less and less as a seedy individual who gazes abstractedly hour after hour into test tubes filled with foul concoctions or chases butterflies through endless acres on balmy afternoons. For this benevolent person, the scientist, life is becoming more and more a bed of roses. Recognition of his merits and his achievements is bringing rewards in the attitude of capital toward his laboratory. Industries are beginning to see in him a wizard who, by some semi-mysterious "hocus-pocus" can create new products and rehabilitate old ones, provided he is let alone long enough and kept well fed in the interim.

ASK this wizard for his version of the future of science. This 1895 genius would tell you that the world is made up of atoms which are in reality the building blocks of everything we see and feel, and with most of these blocks he is quite familiar. The few that are still left undiscovered will be merely grist for his mill when they arrive. With these materials he and his colleagues were prepared to do the work of the world. By the simple procedure of tearing matter apart and building it up again, in a manner quite different from that of nature herself, science was becoming for him the nursemaid of industry and the creator of an artificial environment unlike anything the world had ever known. It was the era of synthetic stuff.

But it was an era of calm preceding a terrific storm, the results of which will not be finally seen even in our own age and probably not for many ages to come. On the fourth of January, 1896, a serious looking German physicist arose before the Berlin Physical Society and made a momentous announcement. William Conrad Roentgen had discovered radio-activity! So new and startling was his find that no word was available for its description and so it was temporarily called the "X ray." Before that august body left the meeting hall,

the last vestige of smug complacency disappeared from the scientific world. What had been dogma became heresy, and what had been as certain as the dawn became as doubtful as the night. Here was a discovery that could not have been depicted by graphs, charts, or wild imaginations. Even in those early days of this new-born science, there were visions of the coming upheaval, of changing concepts concerning the nature of the physical world. But Roentgen's amazing discovery was as the report of a pop-gun compared with the discoveries which followed.

Time intervened, however, between the day when Roentgen played the rôle of iconoclast in the drama of modern science and the day when the decision was reached that science must begin to rearrange her house. During that time there were various contributing discoveries, of which the first and most important was the discovery of a form of radio-activity in nature quite different in some respects and similar in others to Roentgen's artificial production of radio-activity in a tube. It is that discovery which will occupy us now and prepare us for a peep into the topsy-turvy world of 20th Century physics in which the ideas of the microcosm contained within the atom and those of the macrocosm which is the universe march to the music of the spheres.

Baby Irène was but a week old when Marie Curie went back to work to discover radium. Years later Irène has grown up and helps the aging mother in her laboratory. Only a year ago Irène herself won the Nobel prize for new discoveries

ANTOINE Henri Becquerel missed the opportunity of receiving a page in posterity's biography because he was too busy with other things to become the discoverer of radium. We can forgive him, for he passed the honor along to one of the most delightful characters in the history of science, and perhaps the most eminent scientist of her sex—Marie Curie. Born in 1852, Becquerel was descended from a family of well known scientists. His father was Alexandre Edmond Becquerel, who occupied the chair of physics at that progenitor of the technical museum of the machine age, the Conservatoire des Arts et Métiers in Paris. His grandfather, Antoine César Becquerel (1788 to 1878) was an electro-chemist of no mean ability and one of France's most prolific scientific writers.

We find Antoine going about his duties at the École Municipale and we watch him as he unthinkingly lays a piece of uranium ore in a drawer of his laboratory table directly over a sensitized photographic plate. He shuts the drawer and turns his attention to another experiment on phosphorescence which he must complete. Two weeks pass by and Becquerel searches for that sensitized plate. Thrusting the ore aside he passes the plate over to his assistant to be developed. The next morning his assistant is apologetic. The greatest care has been taken in developing the plate and yet it shows a great blotch of light in the center. Had Becquerel been less familiar with photography, his assistant might have been severely reprimanded for carelessness and a great discovery lost to the world for many years. But Becquerel knew that plates are sometimes "light-struck" around the edges, due to a leak in the camera, but "light-struck" in the center alone—never! It was one of those happy moments, such as that which Goodyear had when he accidentally dropped rubber on a hot stove and discovered vulcanization or that Edison had when his ear caught the musical note given off by the stylus of his paper-embossing telegraph repeater and led to his invention of the phonograph. It required no great intellectual effort for Becquerel to go from effect to cause. The uranium ore was giving off invisible rays!

Conclusive as this accidental discovery was, Becquerel was enough of a scientist not to jump at conclusions and he decided to perform the experiment deliberately and satisfy himself that the uranium did give off invisible rays. At first tempted to believe that the uranium itself was the cause of the rays, he repeated the experiment several times and found that other ores gave off radiation but in different quantities. Pitchblende from Bohemia, for example, registered its output of energy on a sensitized photographic plate far too forcefully in proportion to its uranium content to satisfy him that uranium was solely the cause of this phenomenon. There was but one conclusion. Uranium contained another element of great potency. Becquerel knew enough about metallurgy to realize at once that the search for that hidden element would be a time-consuming task. He must find someone else to carry on that work so that he would not be distracted from his other duties. One wonders whether, if Becquerel could have foreseen the effects of his decision, he would have been so willing to let this opportunity slip through his fingers. At all events he did. And that brings us to the story of a 17-year-old Polish girl, Marie Sklodovska, whom we find hard at work in her cousin's chemical laboratory still blushing from a compliment paid her by the great Mendeléev, a giant among contemporary scientists, who had stopped long enough by her side to note the precision and care which she exercised in carrying on a chemical experiment.

Marie's mother had died while she was but an infant and her father had become her constant companion. Two things burned constantly in this young girl's soul. One was chemistry. The other was the sad plight of her fatherland under the Cossack's whip. And so Marie spent those years that other girls give to more frivolous pursuits in preparing herself for a career in science and in plotting with secret societies to free Poland forever from Russian domi-

nance which had long been bitter as gall.

During the winter of 1891, at the age of 24, Marie fled in haste from Warsaw to Paris, which was then, as now, a haven for the political exile. It is here that her real story begins. There is nothing in these first few years in Paris that differs from the oft-told tale of the struggle of great minds. In a garret room she lived on the most frugal rations while she carried on her studies

Drawing by Percy Hale Lund

"They were confronted with scintillating streaks of light glowing like fingers beckoning to continue"

at the Sorbonne. Mendeléev had been bold enough to prophesy for her a great future in the world of science. Yet no one realized better than she that science was, at that time, a closed field so far as women were concerned.

In 1894 she met the reticent, studious Pierre Curie at the home of a mutual friend—the same Pierre who, a few years before, freely announced his belief that "women of genius are rare, and the average woman is a positive hindrance to the serious minded scientist." If his dictum were true, then Pierre must have found genius in this Polish girl, for he secured permission for her to work at his side in the École Municipale. It was not long before this shy physicist wrote to Marie that "It would be a lovely thing to pass through life together, hypnotized in our dreams. your dream for your country, our dream for science. Together we can serve humanity." In the mirror of subsequent history, we can see reflected the truth of this statement, the brain child of a scientist touched by Cupid's dart. The world does not know a more pathetic figure. They married.

Becquerel selected Marie Curie to undertake the arduous research necessary to discover the unknown element. Marie talked it over with Pierre. The only obstacle was the money needed to carry on the work. True to the tradition of scientific genius, they swept this obstacle aside by the simple procedure of borrowing the money. From Austria they secured a ton of pitchblende. In a shed they then began the work of refining, of boiling, of testing, of gnawing away, bit by bit, each known part of that stack of ore, looking for a needle in a haystack without even knowing what the needle was.

They worked from the early hours of the morning until far into the night, taking turns in cooking the ore and checking the results. So much attention to cooking ore and so little to cooking victuals soon took its own toll. Marie went down with pneumonia but Pierre carried on until she recovered. Next their task was interrupted by the birth of a daughter—but not for long. Baby Irène was but a week old when Marie went back to the shed to help Pierre. Grandpa Curie solved the problem and saved the day by coming to live with the little family and caring for Irène during the day.

A year went by and the ton of ore dwindled to a hundred pounds. Again Marie fell ill, and Pierre, worn out by his labors in the home and in the laboratory, was ready to call a halt. No one would help them in their mad search for a product that might well prove to be a will-o'-the-wisp. That a scientist had seen the footprints of a mere wraith upon a photographic plate was not sufficient to merit such a waste of time and money. But Marie held out.

Pierre had been offered the chair of Physics at Geneva, and Marie sadly watched him depart to investigate the offer. He was not away long and on his return he announced his decision to finish the work in the shed first. Marie's good example was beginning to pay dividends. Again they went on with their boiling. Now they had reduced the pile of pitchblende to a handful of bismuth salts which showed a great amount of activity. Out of this Marie isolated a substance that resembled nickel but proved to be a new element which she named "polonium" in honor of her native country. This element was many times as active as uranium, but Marie was sure that there was something else there which they had missed, and the work went on.

With the working capital in pitchblende now brought down to almost microscopic amounts, they strolled one evening after dusk into the shed and were confronted with scintillating streaks of light glowing like fingers beckoning to the pair to continue their search. They accepted the challenge and Marie finally isolated a few crystals of radium salts. When Giotto finished a painting, all Florence was jubilant and a holiday was declared. But when Marie Curie gazed for the first time on radium there was none but she and Pierre to rejoice at the end of a heart-breaking and back-breaking task.

Then came five more years of research before Marie presented her epoch-making thesis on radium and its discovery to the examining committee of the university as a modest condition for her degree. Then happened an event that would gladden the heart of almost any college senior. The committee, composed of most of the eminent scientists of the day, sat in awe during the narration of her work, and were at a complete loss when the time for questioning this modest woman arrived. Then the news rang throughout the world! A woman had discovered a potent substance called radium, that killed mice, shone in the dark, emitted 250,000 times as much heat as an equal amount of coal, produced sores on the skin, sterilized seeds, and killed microbes. Here was news that was news!

The rest of their story is that of honors heaped upon the Curies by every country in the world; of another daughter born of that happy union;

Marie Curie in middle age, when her fame had spread to a world that adored her as its foremost feminine character. Adulation did not spoil her natural simplicity

of the tragic death of Pierre in 1906 under the wheels of a truck on the Rue Dauphine; of the shameful littleness of the men who fought against Madame Curie's election to fill the chair vacated by Pierre, and her election to the Academy of Sciences of France; of her valiant work as an ambulance attendant in the World War; of the gifts of radium to her by the women of America, and of her gift of these to the Universities of Paris and Warsaw; of the establishment of the Curie Institute and of her retirement behind its walls, and of her death on July 4, 1934.

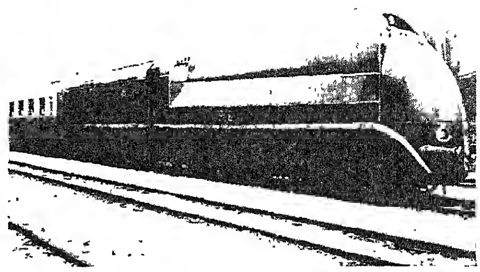
*(To be continued)*

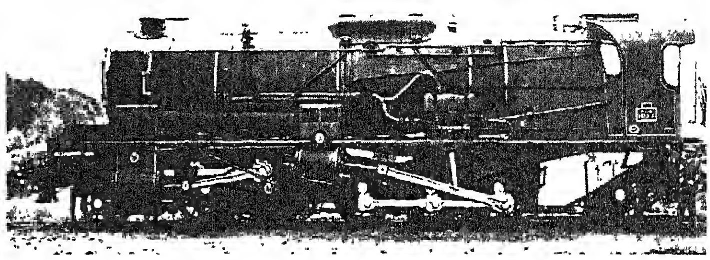
# Locomotives Abroad

WHILE American railroads have been busy streamlining locomotives and glorying in their performance, foreign locomotive designers have not been idle; quite the reverse. Outstanding work has been done by several nations of Europe as shown by the streamlined trains on this page. And even those that are not streamlined are both powerful and speedy.

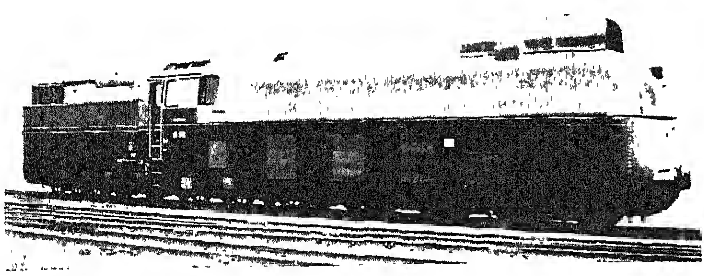
In Europe, as in the United States, steam seems to be the principal concern of railroads. From France, particularly, have come some of the most advanced theories on steam locomotives and the most far-reaching applications. Yet it is understood that France, having perfected and invented better steam engines than her neighbors, is behind both England and Germany in adding new locomotives. Both the latter countries have adopted programs not only calling for many new and modern steam units, but also for overhauling and modernizing their old ones for greater efficiency.

*Right:* A speed of 157 kilometers (97.5 miles) an hour is made on the Paris-Dijon run with a train of 200 tons and this steam locomotive of the Paris, Lyons, Mediterranean Railway. It matches, in streamlining, anything America has done

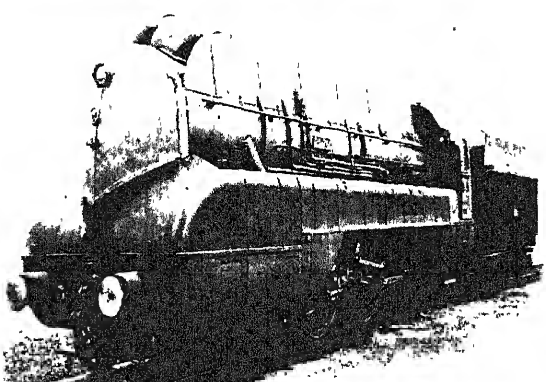




*Above:* Freight locomotive of the same road as that at top of page. Locomotives of this type can develop 3000 horsepower at a speed of 75 kilometers (46.6 miles) per hour, and are probably the most powerful engines of their kind in all of Europe



*Above:* A German type which holds the world's speed record for steam. With a train of 200 tons, 192 kilometers (or 119.2 miles) per hour is the record of this speedy engine

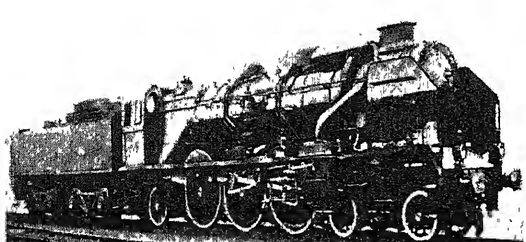


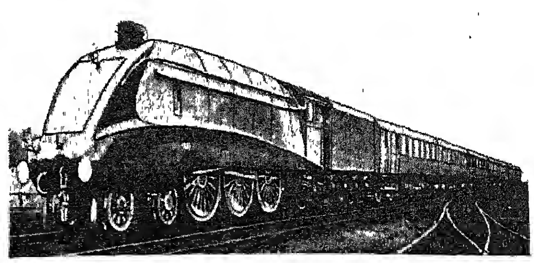
*Left:* Another French example of steam locomotive streamlining which indicates experimentation in an attempt to determine the ultimate form

Photographs courtesy The Baldwin Locomotive Works

*Below:* French, Pacific type locomotive. They have exceeded 93.2 miles an hour with a 400-ton train but regularly make 66.4 miles per hour hauling an express train between Tours and Bordeaux

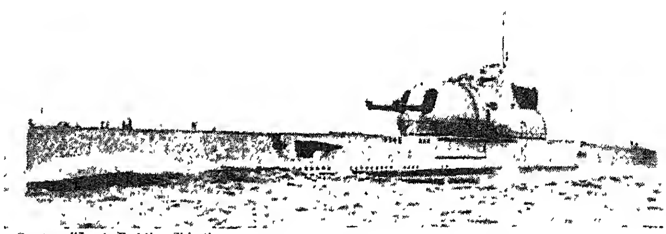
*Below:* A fast British train, the Silver Jubilee of the London and North Eastern Railway. For these trains, the 268-mile trip between London and Newcastle is four hours





# THE SUBMARINE

By WALTON L. ROBINSON



Courtesy "Jane's Fighting Ships"

**World's largest: the French *Surcouf*; 2880 tons (surface), 4300 tons (submerged); two 8-inch, two 37-mm., and four machine guns; 14 21.7-inch tubes**

EVER since its inception, the submarine has been subjected to all kinds of abuse. It has been denounced on numberless occasions as a cruel, cowardly, inhumane weapon. Such criticism has been made chiefly by Great Britain. For years that country has tried to bring about, by international agreement, the abolition of the submarine. At the Geneva Naval Conference of 1927, she was tireless in her attempts to bring the other naval powers around to her way of thinking, but her efforts in this direction were in vain. France and Japan declined to support any such proposal, while Italy listed several conditions before she would consider the British viewpoint. Only the United States sincerely backed England.

It is not difficult to understand the British desire to have the submarine abolished, for it was Germany's U-boat campaign during the World War which nearly was successful in bringing Great Britain to submission. Even now, despite the tremendous advances made since the war in anti-submarine tactics, the undersea boat remains one of the two most serious threats to British sea power. The other is, of course, the airplane. Britain's condemnation of the submarine and her desire to have it abolished prove better than could any other argument its potential effectiveness in the next war.

A few months ago, Great Britain's diplomatic policy in regard to Italy and the Ethiopian War was governed very largely by the respect the British Admiralty had for Italy's powerful air squadrons and strong submarine flotillas. The great Royal Navy is not quite sure of its ability to cope with these comparatively new weapons of warfare at sea. No longer can naval might be calculated by the simple process of comparing battleship tonnage. Other purely military factors must now be included in comparing one nation's naval strength with that of a possible enemy.

In the early period of the World War, the triumphs of the submarine were both numerous and spectacular. This is always the case with a new weapon, for effective means of countering it do not exist and have to be developed. But methods of combating the submarine were found: improved underwater protection was given battleships and cruisers; large warships and convoys of merchantmen were escorted by destroyers, sub-chasers, and so on; depth charges were dropped on the submerged U-boats; and mine fields were laid close to the bases from which they sallied forth on their cruises of death and destruction.

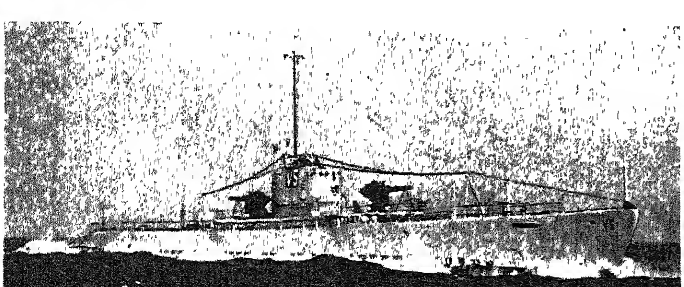
THAT these methods were effective is proved by the fact that in the four years of the war, 199 German submarines were lost and with them perished 5132 officers and men, the very flower of the personnel of the Kaiser's navy. By far the greater part of these losses occurred in the last two years of the war, by which time the various anti-submarine devices and tactics had reached an advanced stage of development. Before the end of the conflict, the task confronting the U-boats was indeed hazardous. The business of getting to the open sea and returning to port after a cruise was full of grave danger, due to the presence of the mine fields, while it was extremely difficult to attack successfully a large convoy escorted by numerous anti-submarine craft.

Despite the fact that the German U-boat campaign was finally conquered by the Allied navies, the submarine emerged from the war with greatly increased prestige. Previously it had been considered an experimental craft of doubtful value, suitable, at best, only for coastal defense. Even Germany, who later was to place such boundless faith in her U-boats, possessed only 27 of them ready for service at the outbreak of hostilities. On the other hand, Great Britain, France, and Russia had, respectively, 75, 64, and 30 in a completed condition. Moreover, each of these three powers had under construction more undersea craft than had Germany. Today, France possesses the strongest submarine force in the world. She has, built and building, some 80 modern submarines, among them being the world's largest: the 2880-ton (surface) *Surcouf*. When submerged, this huge undersea warcraft displaces 4300 tons.

The submarine, like the airplane, has progressed enormously since the war. In the next conflict involving naval powers, both will have far more important and interesting missions to fulfill than they had in the past one, in which they merely gave a small idea of what they will be capable of doing in the future.

By the end of 1918, the submarine had become specialized into three distinct types: one, which used as its principal weapon the torpedo (the true arm of the submarine); another, which was equipped, in addition, to lay mines; and a third, usually referred to as the submarine-cruiser, which depended in large measure upon the gun for its offensive power. Of these three types, the last is the least adapted to the conditions of real submarine warfare, for an undersea boat which attempts to attack on the surface in order to use its guns is always at a great disadvantage; the slightest injury, which would not seriously affect the fighting ability of a surface ship, carries with it for the submarine the impossibility of submerging, thereby causing it to lose its *raison d'être* and only real defense.

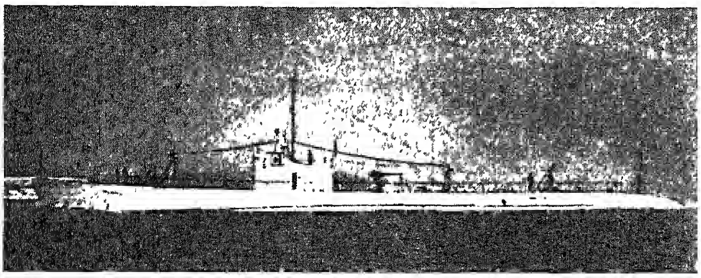
On the other hand, the ordinary submarine (that is, one which relies upon the torpedo to carry out its work of



**Fleet submarine *Narwhal* (U. S.) has two 6-inch guns, six 21-inch tubes. Slightly smaller than *Surcouf*, she is of the "cruiser" type, now passing out of favor**

# IN THE NEXT WAR

## Submarines are Here to Stay . . . In Most Modern Navies . . . Many New Ones Building . . . Their Mission Has Changed . . . What They Can and Will Do



The *Cachalot:* one 3-inch anti-aircraft gun, six 21-inch torpedo tubes. Submarines now building have 1330-ton surface displacement against *Cachalot's* 1110

destruction) and the mine-laying submarine are able to work submerged, and therefore in secrecy. In other words, these are submarines pure and simple. Aside from their regular and legitimate mission of torpedoing hostile warships and laying mines in enemy waters, they are well suited to carry out scouting and observation operations. Moreover, in the opinion of some foreign officers, they can make poison-gas attacks upon the enemy's warships at anchor in port and upon his naval bases, though in carrying out this latter mission the lives of the enemy's civilian population would, of course, be jeopardized.

As regards its value as a scouting vessel, the submarine suffers from two very severe limitations: its low speed, both surface and submerged, and its inability to see any considerable distance, due to its lowness in the water. In spite of these disadvantages, however, the submarine's ability to remain undiscovered for long periods at a time in a comparatively small area must not be overlooked.

A submarine operating submerged outside a hostile port could observe constantly for many days the enemy's movements without ever being seen and possibly without its presence even being suspected. It will be realized at once that this is an excellent quality and one possessed solely by this type of naval craft. During the war, both the British and Germans employed their submarines on such missions of vigilance, and in both cases the results obtained were very satisfactory.

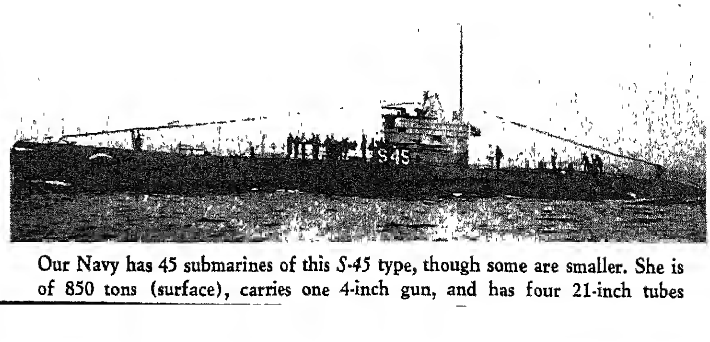
As pointed out in a previous paragraph, the effectiveness of this scouting is limited by the low freeboard of the submarine. This inability to see any great distance is increased when the submarine is submerged, as it must be at all times during the day while closely observing an enemy naval base. At such times, the submarine's visual capacity is perforce limited to that of its periscope, which extends at most only a few feet above the surface of the sea. In such types of scouting, high speed is not really as essential as it is, for example, in tactical scouting at sea with the fleet. This is so because, in the case under consideration, the submarine's task is not so much one of *scouting* as it is of constant *observation* of the enemy's movements and reporting them as soon as possible by radio. This latter is the most important and the most difficult task of the observation submarine, for it is obvious that the information obtained is quite valueless if it is not promptly and accurately transmitted to the proper authorities. In making her radio report the submarine must at the same time endeavor to keep the enemy in ignorance of her presence off his base. During the World War, the position of many German U-boats became known to the British through the careless manner in which they wirelessed their reports.

Attacks against the enemy's merchant shipping doubtless will be one of the most interesting aspects of the naval operations of the next war, just as they were in the past one. For this kind of warfare the submarine possesses admirable qualities, as was evidenced by the successes of the German U-boats against Allied sea commerce. The submarine's cruising radius is wide and is constantly being increased in the new boats. During the war, the length of time which the Kaiser's undersea boats were able to remain at sea was limited primarily by the cramped living conditions on board, which caused the early exhaustion of the crews. The scant number of torpedoes which could be carried was another limiting factor. These two defects served to increase greatly the number of returns to and departures from port, and it was while making these that the submarines ran the greatest risk of destruction.

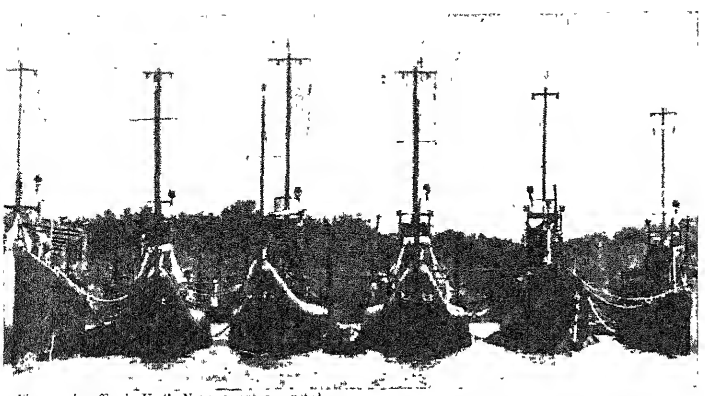
It is not likely, however, that the strategic conditions of the past war will be repeated in the next, and they certainly would not apply in any war in which this country became involved. Moreover, the submarines of today, due to increased size and the use of weight-saving metals in their construction, are able to provide more habitable quarters for their crews, thus making possible longer stays at sea, from the standpoint of the health and morale of personnel alone.

The mission of the mine-laying submarine is frankly an offensive one. It is that of laying its death-dealing cargo in front of the enemy's ports and naval bases. In this work the submarine has the incalculable advantage over the surface mine-layer of being able to operate in absolute secrecy. It is true that the mines laid by a submarine can never be numerous, but the small groups of them thus laid can be placed in locations carefully selected beforehand by the very submarine which lays them, thus assuring that they are placed along the route most frequently used by the enemy's ships. This same submarine can also report the movements of the hostile ships, although, as has already been seen, in doing so she runs serious risk of revealing to the enemy her presence and that of the mines she laid.

Having now seen what the ordinary torpedo-submarine and the mine-laying submarine can do, let us for a moment




Our Navy has 45 submarines of this *S-45* type, though some are smaller. She is of 850 tons (surface), carries one 4-inch gun, and has four 21-inch tubes



Photographs official, U. S. Navy, except one noted

**Fleet submarines. At left is one of our largest, the *Nautilus;* next are three oldest—the *Barracuda, Bass,* and *Bonita.* At right are the *Dolphin* and *Cuttlefish***

consider the large submarine-cruiser, which carries a number of relatively heavy guns as its principal armament. (All submarines, of course, have torpedo tubes.) Unlike the torpedo or the mine, the gun is not a suitable arm for the submarine, due to reasons explained earlier in this article. For the submarine the gun should always be regarded as an auxiliary weapon, just as should torpedo tubes on a battleship or cruiser be subordinated to the gunnery armament. In the past war, with the exception of the British submarine-monitors of the *M* class, which carried a single short caliber, 12-inch gun and was designed for a special task off the Belgian coast, guns were placed on submarines largely to compensate for the scarcity of torpedoes; the cost of a torpedo was and is very high, and a submarine has stowage for only a small number of them.

Submarines, nowadays, are provided with one or more anti-aircraft guns. These are for beating off airplane attacks, although in such attacks the undersea boat's best defense is to dive to as great a depth as possible. In the war of the future, as in the past one, it will indeed be dangerous for the submarine to remain on the surface and attempt to sink a merchant ship by gunfire, much less any type of naval craft, no matter how small. Doubtlessly many readers recall how, on several occasions, German U-boat commanders received unpleasant surprises from inoffensive-looking Q-boats—merchant ships with cleverly concealed armament and usually manned by regular naval personnel.

Following the failure of the effort to have the submarine condemned and abolished as a legitimate weapon of naval warfare, an attempt was made to impose upon its use certain restrictions which it could not possibly respect. The fact should be plainly evident that to force a submarine to come to the surface to exercise the right of search is to place it at once in a situation of inferiority in respect to the merchant ship, which quite possibly may have been armed at the very commencement of hostilities. In war, every stratagem is fair and it would be childish to believe that agreements which fail to take into account the imperative necessities of war will be respected once a conflict breaks out. Every such international agreement should be drawn up with a clear understanding of the exigencies of war. If this is not done, the accord will become but a scrap of paper at the sound of the first gun. Perhaps for a time the submarines would abide by the rules laid down for their operations, but just as soon as one of them was sunk by an armed liner, tramp steamer, or Q-boat, reprisals would follow at once, and the situation would be the same as that which existed in the last two years of the World War.

THE abolition of the submarine is a very remote possibility indeed. Great Britain is almost alone in her desire to have the submarine outlawed; the United States is her only supporter. The faith which the world's navies have placed in the submarine is made clearly evident by the fact that practically every nation which maintains any navy at all possesses a number of submarines. Including the five leading naval powers, no less than 25 nations have submarines in their naval establishments. These possess between them about 575 submarines built and building. Some 15,000 officers and men, the pick of the personnel of the world's navies, man these undersea fighting craft.

The submarine will continue to figure prominently in the future naval programs of all the sea powers for the very simple reason that it is far too valuable a weapon to be discarded. To second-line navies, and to very small ones, especially, it offers one of the most effective means of defense for the scant amount of money that can be spared for such purposes. France or Italy, for example, cannot compete in battleship strength with Great Britain, but the fact that both countries possess a large number of modern submarines, as well as a powerful air force, makes the British Admiralty quite apprehensive.

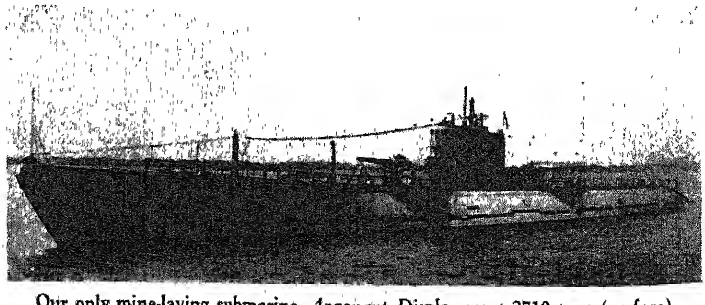
Britain's naval history is replete with victories over French fleets, victories won in the 18th and 19th Centuries when it was simply a question of ship-of-the-line against ship-of-the-line and frigate against frigate. In those days it was easy to calculate comparative naval strength—just a matter of adding up the number of line-ships and frigates and the guns they carried. But today, with submarines and aircraft very much in the picture, the task is a great deal more difficult, for with a little luck a submarine displacing only 500 to 1000 tons quite possibly could send to the bottom a huge 35,000-ton dreadnought.

It is evident, therefore, that a very small country, if it possesses a few modern, efficiently manned submarines, can command a degree of respect from even the largest sea powers. In view of this fact, is it at all surprising that those navies other than the two largest have steadfastly refused to consider the abolition of this comparatively new naval weapon?

The submarine is the most unusual type of warship ever to be evolved. Naval history does not record any other class of ship which, considering its relatively small size, ever exercised such a profound influence upon fighting at sea as did the submarine in the last war, and there is every reason to believe that its influence in the next will be equally as great, if not indeed greater—especially in the case of a European conflict.

●

*If we are to credit newspaper estimates, Russia now nears the top of the list in total submarines built. Who knows? Russia remains the enigma of modern nations.*—The Editor.



**Our only mine-laying submarine, *Argonaut.* Displacement 2710 tons (surface), 4080 (submerged). Armament: two 6-inch guns, four 21-inch tubes, and 60 mines**

# TEXTILE GLASS

## What Are the Future Possibilities of Glass Fibers Produced by High-Pressure Steam? . . . Already in Wide Use for Electrical and Thermal Insulation

WHAT are the possibilities, if any, of glass as a textile fiber? Much of the fanciful has been written about so-called glass dresses, and hats and hosiery of glass, but thus far nobody seems to be wearing them, and apparently nobody knows anyone who is actually producing such Aladdinesque articles.

Glass for textile application is here, however, and although its real value is perhaps less sensational than some of the stories it has inspired, it is undoubtedly destined for remarkable achievements. Discovered long before the Birth of Christ, glass is, nevertheless, thanks to a scientific America, in some respects as new as tomorrow's newspaper.

Recent research and development have made glass the most amazing of all examples of industrial diversification of a basic material, and textile glass is not only the newest instance of this, but in many ways it has the more alluring potentialities.

Broken into tiny filaments by steam under terrific pressure, glass is being assembled into strands, spooled into thread and yarn on modern textile machines, and woven into cloth of pure glass. Such fabric finds its greatest use at this time as an insulating and filtering material.

In its new fibrous rôle, glass for thermal insulation is beginning to be a factor of vast financial significance in the saving of power and heat in industry, in making it possible to use smaller units to create more energy, to add greater efficiency to present equipment, and to add to the life-span of usefulness of that equipment by reducing operating strains that hasten replacement.

Glass thread is being woven into tape —varying in width and resembling rolls of ribbon—to insulate electric wires, cables, and armatures; and is provided in spools of thread or yarn to wrap individual small wires.

Glass, as everybody knows, does not burn and, in textile form, it retains all its other inherent characteristics—stability; high resistance to moisture, acids, salts and vermin; and non-conductivity.

Fiber for fiber, glass has greater tensile strength than steel, and while that characteristic cannot be utilized fully at this time, it is a highly important factor for insulation glass both in textile and pack form.

Textile glass tapes for high-temperature electric insulation, for example, have a tensile strength of 250 pounds per square inch, which allows for tighter wrapping. Other insulations average only 50 pounds for a tape of the same dimension, and only one half the thickness of glass tape is needed to supply a comparable insulation.

AS a filtering medium, glass cloth is rapidly moving into many types of industry for varied utilization. Recently it was discovered that a glass cloth used to filter certain acid remained efficient for 40 days while one of another kind of fabric commonly used for the purpose breaks down in from eight hours to ten days.

Fibrous glass in mat or pack form for insulating buildings and ships has been in use for some time, but it is now being applied to insulate streamlined passenger trains, railroad refrigerator cars, airplanes, buses, domestic refrigerators, electric kitchen ranges, electric broilers, pipes and ducts of all kinds, and industrial boilers and furnaces.

With its development now as an insulating material in thread, yarn and cloth form, it is not unreasonable to assume that the day is not far distant when textile glass will be successfully combined to assist the commoner fibers, and to weave all-glass draperies, curtains, and tapestries for theaters, ships, and hotels to reduce fire hazards.

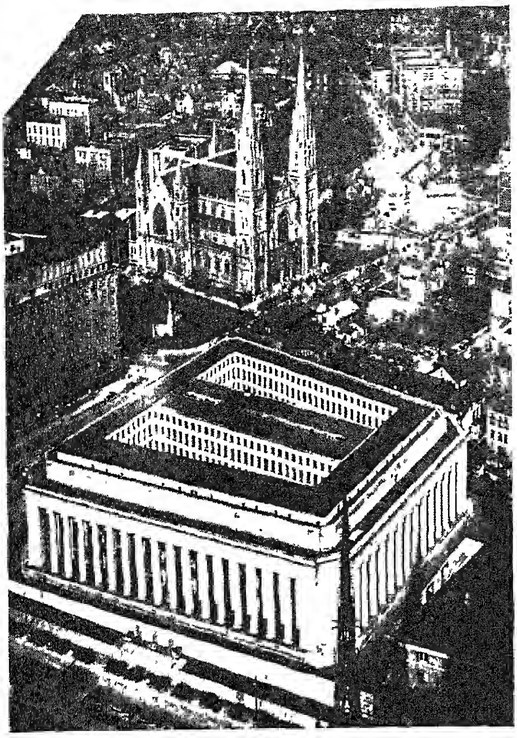
Fibrous glass is not new, but its practical commercial application and constant refinements today have been made possible by the high-speed production process discovered by the Owens-Illinois Glass Company.

Its fibers produced at a speed greater than the muzzle velocity of a rifle bullet, each less than 1 20th the diameter of human hair but stronger than steel, a 12-ounce bottle enough to make a single strand nearly 5000 miles long, the fascinating present of glass is rivaled only by its future possibilities.

Courtesy Owens-Illinois Glass Company

**All glass, from the milk bottle to the spools of threads and yarns, the pipe insulation rolls (left), the tape (center foreground), and the filter cloths (right)**

# RESEARCH BY

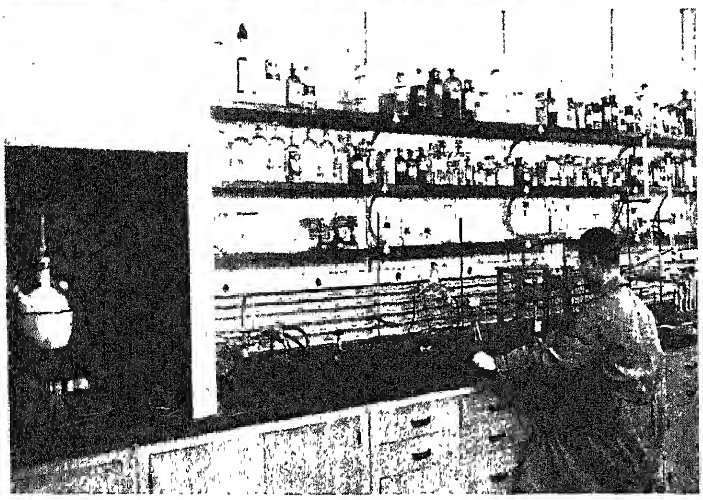


Even the roof of Mellon Institute's handsome new home is scientific. There are no projections since fumes are disposed of by an inset arrangement. Weathering tests may be conducted on certain sections of the roof

THE "National Asset" that is Mellon Institute officially dedicated its Ionic-pillared new home on May 5 to 9. Not only are its research facilities thus enlarged so that research fellows have more space and equipment for fact-finding; the building and all its appurtenances are products of the latest scientific knowledge.

As guest speakers at the dedication there were three Nobel laureates: Dr. Irving Langmuir (General Electric Research), Dr. H. C. Urey (heavy hydrogen), and Dr. W. P. Murphy (pernicious anemia treatment).

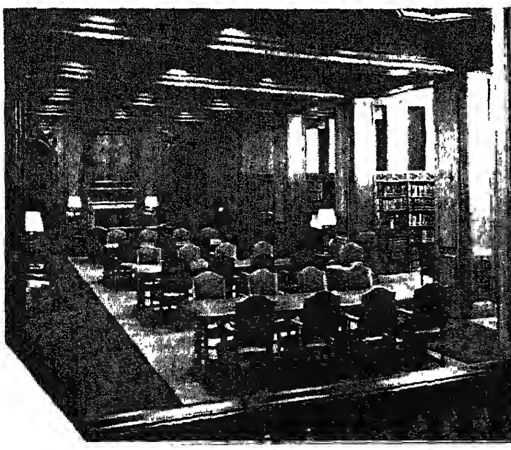
According to Dr. E. R. Weidlein, Director of the Institute, its function is four-fold. It is an industrial experiment station, a training school for young scientists, a center of investigation in pure and applied science, and a clearing-house for specific scientific information. Founded in 1913 as a result of the fellowship system inaugurated by Dr. Robert Kennedy Duncan at the University of Pittsburgh in 1911, Mellon In-



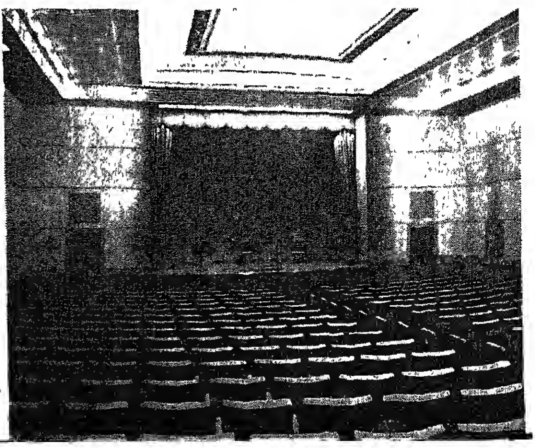
All unsightly features such as piping and ducts are concealed in this pharmaceutical laboratory in the new building. Note ample space in neat drawers, the adjustable shelves, and hood for carrying away fumes

Broad research in refractories is conducted through the use of small kilns such as this will be

One of the most impressive rooms is the library which is carried out in the style of the Renaissance. In this room and the adjoining stack-rooms, facilities are provided for a collection of 100,000 volumes, most of which are on science and engineering



The auditorium which will be used for lectures and other meetings of a scientific nature. Seating capacity is 350. Motion picture and stereopticon equipment is provided for demonstration purposes in connection with many activities of the Institute

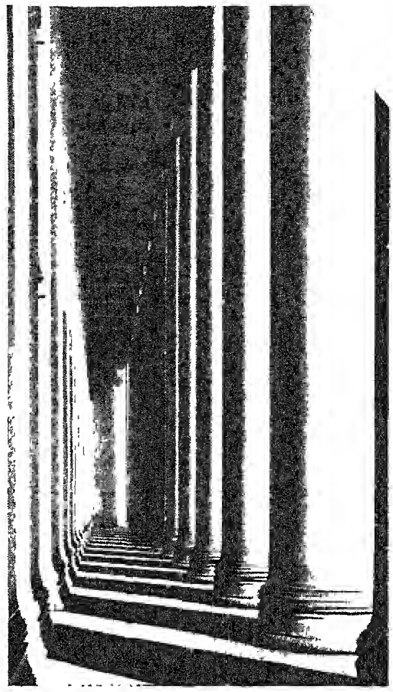


# PARTNERSHIPS

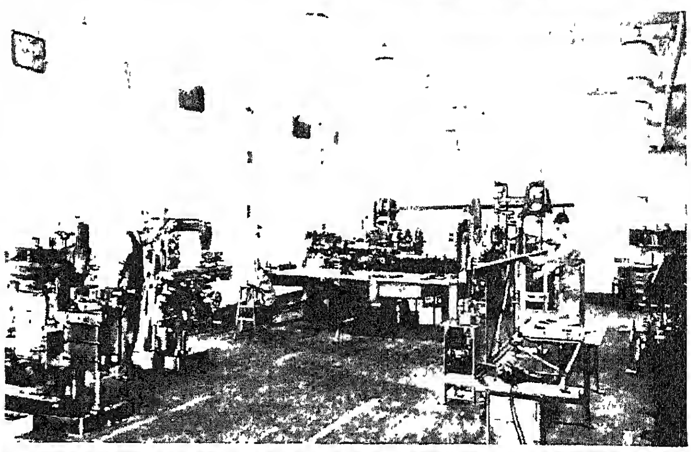
stitute functions as a working partnership between science and industry. Companies in any given field can band together to finance mutual research, the results of which become the common property of participating firms. Most of the industrial investigations, however, are sustained by individual companies.

In the splendid new building illustrated on this page, the fifth to eighth floors, inclusive, are devoted to laboratory use, though each floor has special rooms. Standard services include air; gas; cold, hot, and distilled water; single- and three-phase current; and currents of special characteristics.

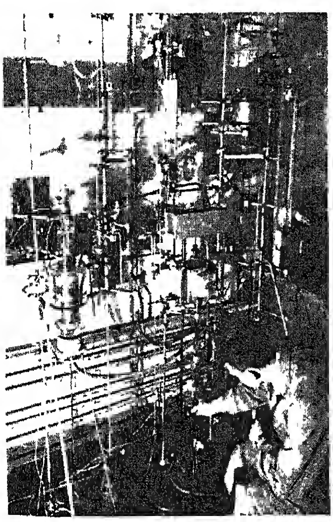
Practically any conceivable type of research can be conducted with these new facilities. Mellon Institute has already brought ten new industries into existence through applied research, and has developed or invented 650 new processes and products. These have ranged from medicines to edible sausage casings, from steel flooring to razor blades.



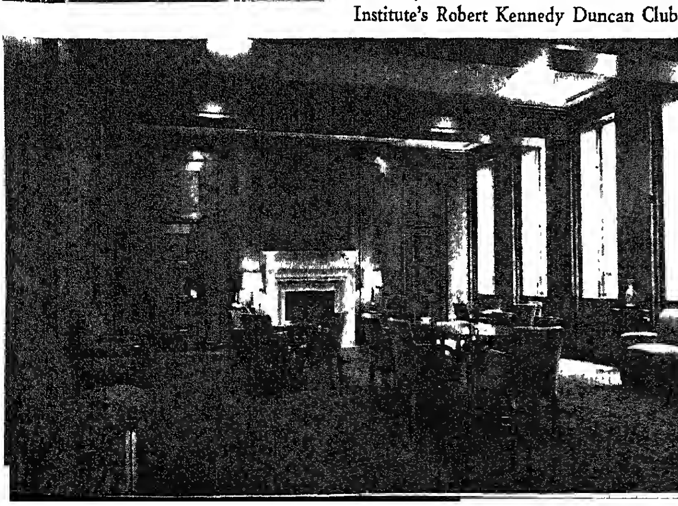
Marvels of craftsmanship, the 62 limestone monolithic columns in the building were turned on huge lathes. Only three workmen could do this exacting work. Each column has an average diameter just under six feet, is over 42 feet high, and weighs 60 tons; they have no seams



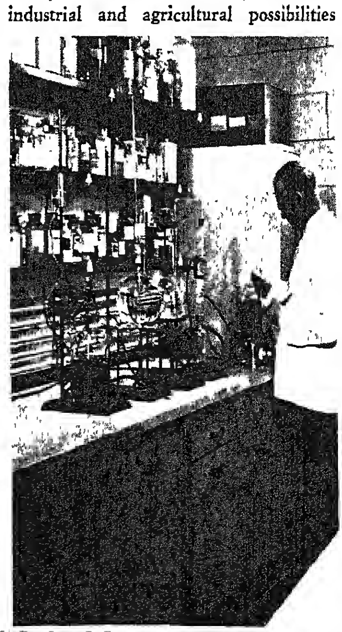
Frequently a research fellow prefers to perfect his own equipment for some special purpose where precision is paramount. He is then allowed to use an adjoining shop



Complicated and elaborate indeed is much of the equipment needed today in modern research laboratories. The complex set-up shown here is an excellent example —it is used in glass technology research



Part of the human side of the Institute: the largest of a suite of rooms reserved for recreational purposes, informal conferences, and for social activities of the Institute's Robert Kennedy Duncan Club



A corner of one of the laboratories emphasizing the clean-cut design of all facilities. This one is the scene of a discovery in insecticides likely to have industrial and agricultural possibilities

# SHERLOCK HOLMES OF THE

## The Microscopic Identification of Wood by Forest Laboratory Experts Solves Crimes and Convinces Juries . . . as in the Famous Hauptman Murder Case

By MARY BRANDEL HOPKINS

A BUILDER suspects his contractor of using a substitute where pine is specified. . . An equally serviceable native wood is sought to replace a wood previously imported for a given purpose. . . A home-made bomb filled with shavings kills the recipient. . . Grapes or other fruits packed in sawdust, butter and cheese packed in wooden boxes pick up a peculiar taste. . . A young married couple buying furniture is confused by the similarity in appearance between mahogany and mahogany-finished birch or gum wood. . . Inspectors with years of experience differ in their opinions as to whether a given lot of railroad ties is of the more desirable white oak or the less durable red oak. . . Musicians or antique furniture collectors desire to repair rare old pieces with the same wood originally used. . . School children making collections of wood are puzzled about specimens.

The solutions to these and more than 1000 other cases which yearly perplex laymen the country over all hinge on the identification of wood species, for which the Silvicultural Relations Department of the United States Forest Products Laboratory at Madison, Wisconsin, is the center. There samples from all over the United States, having an important bearing on extending and improving the use of wood or originating in controversies incident to marketing of forest products of all kinds, are handled for the United States Department of Agriculture.

Costly litigation frequently hinges upon the result of an examination of a little sawdust, wood flour, or a few slivers. Identification of wood in the Lindbergh kidnap ladder by Arthur Koehler, in charge of this department, has become a classic example of this remarkable government service which is offered without charge to its citizens. As a matter of fact, Sherlock Holmes was not abler than Mr. Koehler, his colleague, Dr. Eloise Gerry, and their skilled assistants. They have added microscopic equipment to Sherlock's magnifying glass, and are proving day after day, beyond the shadow of a doubt, that woods which appear as like as two peas to the naked eye may be of an entirely different species. While color, odor, weight, and hardness help in identifying woods, such qualities as a rule are too variable to be used singly in distinguishing a large number of woods. Definite and dependable distinguishing characteristics of species, which make positive identification possible, are revealed only by the microscope. When photographic enlargements of the microscopic sections are introduced as evidence in the court room, they afford for the jury, among other things, indisputable proof or disproof of the fulfilment of a contract.

A case in point is that of a Chicago buyer of railroad ties. The dealer claimed to have sold him white oak ties. The purchaser sincerely believed them to be the less valuable red oak. Called upon to settle the matter, the tie inspectors representing both sides claimed they could tell red from white oak by looking at the side of the tie through a pocket magnifying glass. Neither would accept the judgment of the other, but agreed to submit the case to the Forest Products Laboratory. Together they brought to the laboratory experts 90 samples of disks of wood from the ends of the ties. Under the microscope, the distinction is so evident between the few round, separate pores of the red oak summer wood (Figure 1) and the numerous fine, angular pores which form patterns in the white oak summer wood (Figure 2) that there was no room for dispute. It happened that buyer and seller both had been partially wrong and partially right in certain of their contentions.

At times wood identification goes a step beyond the mere settlement of disputes by affording the key to the solution of crime. Aside from the more recent Lindbergh case, there is the rather well known example of the "Christmas gift bomb." The explosive received in the guise of a Christmas box by a highway commissioner killed his wife as she cut the cord on the package. Ballistics experts traced the metal used in the home-made bomb to a particular man's

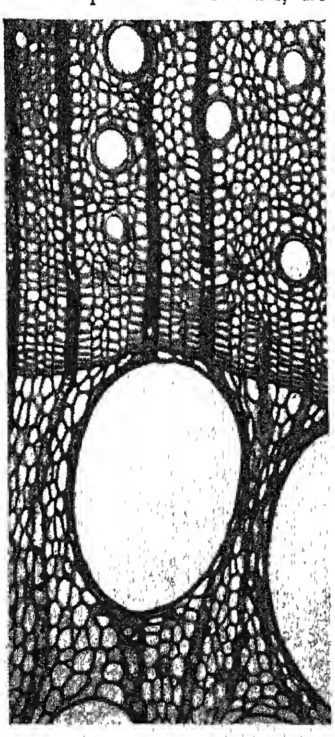


*Figure 1 (at left):* **Upper half shows summer wood of red oak. Note in this the pattern of round, separate pores**

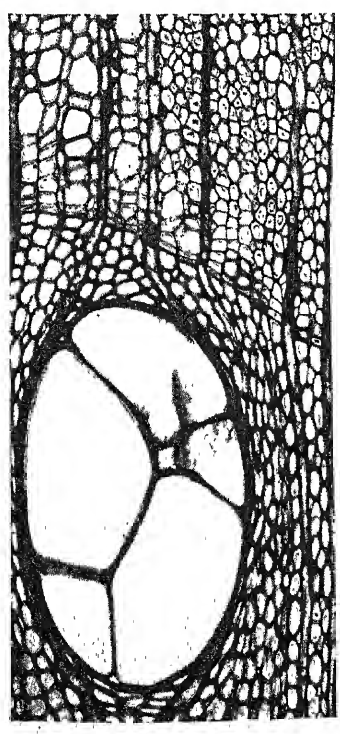


*Figure 2 (at right):* **Upper half shows summer wood of white oak, with patterns of numerous fine, angular pores**

# FORESTS

workshop. That alone was not sufficient evidence. When the Madison laboratory identified the shavings inside the bomb as having come from the same workshop, the substantiated evidence was fairly conclusive proof of guilt.

After the tree is cut and lumber sawed, nothing short of a microscope will indicate what portion is strong and which is weak and should be withheld from use where it will not serve adequately. In southern swamps, the lower part of the tree which grows in the water often produces a swelled butt, with light, soft, weak wood. The wood from the under side of leaning trees has different properties from normal wood. Such differences can be detected microscopically, and the wood put to service accordingly.

Difficult as it sounds, it is also possible for laboratory experts to identify wood in the form of paper! The microscopes are called upon for this feat when it is desirable to know from what species or mixture of species and pulps a given paper was made. More difficult because of the small fragments available, but not impossible, is the identification of wood from sawdust. That becomes desirable, for example, if fruit packed in sawdust acquires a peculiar taste. The species from which the sawdust came can then be held accountable and barred from that particular use in the future. The same is true of wooden containers which impart an unusual taste to cheese and butter packed in them.

When the search is for substitutes to serve equally as well as a more costly and less available wood, microscopic investigation is called upon to determine the woods with the greatest promise of giving the required service.

The ultimate in identification is probably achieved in determining the species of wood flour, a very fine sawdust used in linoleum, phonograph records, and for polishing jewelry. The purpose is to detect undesirable substitutes for the species recognized as most satisfactory.

In the laboratory, the process of identification of wood samples is to cut off with a sharp razor a paper-thin slice and place it under the microscope. With their distinguishing characteristics thus revealed, it is a simple matter to single out oak, elm, pine, or birch. The nature of wood structure being very conservative, it is possible to distinguish even between each of the approximately 100 species of oak. Yet the microscope cannot always be depended upon to differentiate between the many varieties in the same species, as among the different birches or true firs. On the other hand, for easier wood samples, a hand glass magnifying 12 to 15 diameters identifies them. For comparison with samples submitted, thousands of accurately classified wood specimens as well as permanent microscopic slides made from them are on file at the laboratory.

THE value of wood identification extends even to the retail purchaser. For the wary buyer of furniture, it is no trick to distinguish between mahogany and birch or gum wood which may be stained to resemble the costlier wood. In that instance no laboratory test is required to set him right. He need but remember that in mahogany (Figure 3, left) the pores of the wood are readily visible to the naked eye. In birch (Figure 3, center) they are barely visible, and in gum (Figure 3, right) they are visible only under the microscope.

Three basic structural divisions are the starting point for the identification of wood samples. Either the wood has vessels or pores which are diffused rather evenly throughout each year's growth (Figure 4, left), or are arranged in a ring at the beginning of the annual growth ring; or it has no vessels or pores (Figure 4, right).

The oaks are "ring-porous woods." And while it is impossible to distinguish individual members of the white oak group from each other, white oak (Figure 2) is easily distinguished from red oak (Figure 1) under the microscope. Both have a layer of large pores in the *springwood* (lower parts of both illustrations) of each growth ring. The characteristic which distinguishes them, and which settled the differences of opinion between the railway tie inspectors, is the size and shape of the pores in the *summerwood* (the outer portion of the annual growth ring, at the top in Figures 1 and 2).

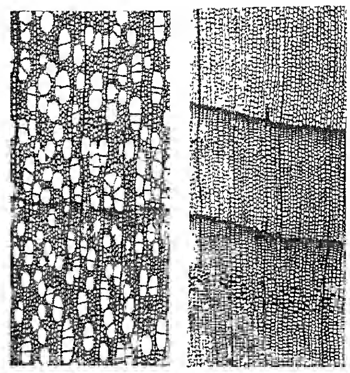


*Figure 4 (left):* Aspen or popple, a diffuse, porous wood with uniformly scattered pores. *Right:* Red cedar *(Juniperus v.)*, a type of wood which has no pores or vessels

One of the means of dating Indian ruins and cliff dwellings in America's Southwest has been by identifying and determining characteristics of groups of a tree's annual growth rings, which is a science in itself. In these rings are preserved the record of the tree's annual growth, which, of course, is largely affected by rainfall and other climatic conditions. In so dry a region as the Southwest, good rainfall shows markedly in the annual growth rings. Even in fossil wood samples, buried deep in the earth, it is usually possible to identify the wood, thus gaining information about the vegetation of the period which helps to date the deposits. Likewise in petrified wood, where minerals have infiltrated the cells, much of the arrangement of the tissues and the distinguishing characteristics of the cell structure may be seen and identified.

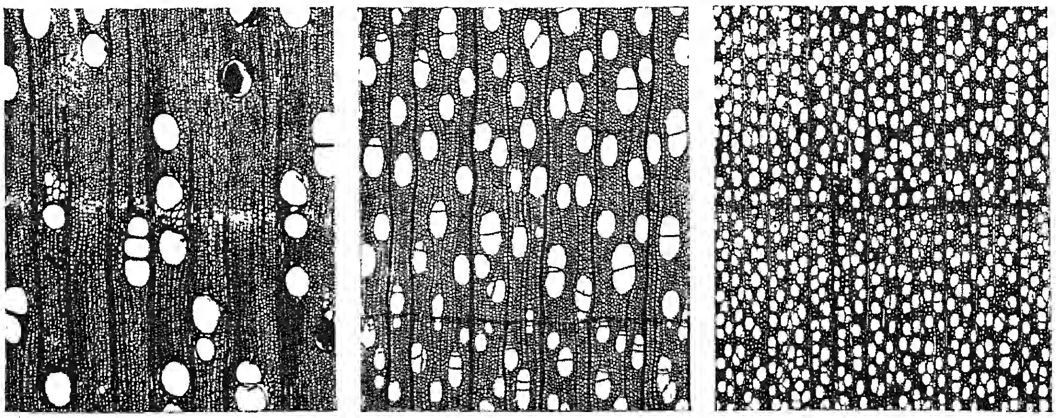


*Figure 3:* **Mahogany, birch, and gum magnified 25 diameters, to show relative aspect of pores. In mahogany *(left)* the isolated pores are readily visible when examined with the unaided eye. In birch *(center)* they are confused but in gum, invisible**

# Is Nature Kind?

## Throughout Nature's Realm the Almost Universal Rule is Tooth and Fang, Whether We Like it or Not, and Most of Us Don't . . . Fact Versus Fancy

By S. F. AARON
Illustrations by the Author

IN the imaginative mind of man, pleasing delusions are too often given place as the findings of scientific observation. Numerous examples of error are apparent everywhere: notably, the "joyous songs of birds," the "music of the spheres," the "peaceful" woods and many other poetic allusions and illusions—"There's never a leaf nor blade too mean to be some happy creature's palace."

Now, in many such beautiful fancies there is a sufficient element of truth to make them the more appealing, and who that are worthy among us, however addicted to seeing things exactly as they are and not just as they seem to be, will not fairly snatch at the semblance of beauty, rather than sordid and gruesome facts?

The poet and the naturalist, however, look at nature through vastly different eyes, even though the naturalist may have a poetic streak and the poet be a close observer. The truthful, careful lover of nature simply avoids the imaginative that goes beyond truth; the poet more easily ignores hard facts for the sake of beauty.

Yet, above all, we must face the truth, which is too often crushed to earth by beauty. The truly scientific aspect of nature, of physical and mental forces, demands an adherence to facts and the expression thereof in terms exactly coinciding with that which has been and may again be observed; and so it may readily be observed that in nature there is a general rarity of happiness, also that any evidence of joyousness is imaginary, and that peacefulness is almost totally absent alike among creatures that seek their food or are sought for food.

THE face of nature, instead of being one large, happy visage, as the nature-lovers-minus-scientific-acumen would have us think of it, is one large, deep scowl resulting from murderous impulses. Instead of peacefulness and content throughout, it is an arena of injury, torture, and death. Everywhere that the student turns to observe animal life closely, he sees among the almost innumerable species a continuous effort to maintain existence. The frequent failures of individuals in nature to survive, or to continue in comfort, accounts for the total lack of what humans may correctly term happiness as derived from and appreciated by the more highly developed mentality of man.

When a poetically-minded observer speaks of the songs of the happy birds he expresses a very common error easily corrected by trivial observation, but an error which, nevertheless, has generally been overlooked. All birds sing with exactly the same motive as crowing roosters and gobbling turkeys; that is,

The weasel barely misses chickaree, the red squirrel, for dinner

as a challenge to others of their species and sex. Their song is merely an expression of ego in relation to possible rivalry. Just so is the soft, almost inaudible trill of the grasshopper sparrow and the mocking-bird's brightly varied performance, the twitter of woodland warblers, and the peculiar cadences of the veery; there is not a note that does not express the candid notion that "I am monarch of all I survey, and let all others keep off." There is also another and more practical purpose: the loudly singing bird near the nest, far from caroling to his lady-love, attracts swiftly moving winged enemies to his whereabouts and thus away from the nest.

These impulses, derived from rivalry and the need of protection of the young, may be observed in male birds that sing the very loudest and most beautifully when fighting, and before and after coming to grips with a competitor because of the very common disloyalty of his mate.

Two Carolina wrens will sing nearly every moment that they are bill to bill in a stupendous effort to destroy each other, often falling to the ground, half with exhaustion, but still musical. Cardinal grosbeaks, orioles of several species, vesper sparrows, and brown thrashers follow the same practices; and so varied, lively, and more rapidly given are the notes of the latter, especially, that it is a duet very much worth hearing. Another proof of the purpose of song is when our yellow-breasted chat, the yellow-throat, the veery, and the European nightingale burst into melody at night after a stone is thrown into the thicket not far from where the female bird is keeping their eggs warm. The spontaneous medley is quite evidently given in anger toward an imagined interloper of their own kind.

ANOTHER common poetic error concerns that which we view only from a distance, without familiar insight into exactly what is continually and tragically taking place everywhere in woods and fields, over and within the earth and its waters. It is not surprising that the lover of entirely beautiful things sees only quiet and peace, but upon closer observation this idea is tragically dispelled. There is not a spot a yard square, in grove and meadow, in forest and thicket, on hill or plain, that is not almost continuously beset by death-dealing forces. There is never a leaf or blade too isolated to be the arena of a tragedy.

Calamitous occurrences which constantly take place in nature, with the most direful results, go far toward upsetting the pleasure to be derived from nature study. To the humanely constituted investigator, the horrible ends

which overtake animals seem to cry for some alleviating element of sympathy from nature. This often leads to an emotional denial of her heartlessness, and a wish-fulfilling substitution of gentle influences. But science cannot dodge facts, even to favor its inner feelings.

Paramount among these tragedies is the destruction of young quadrupeds and birds, the killing of mother creatures and the consequent starving of the young. Nature advances her interests in the formation of species by purposes not in the least allied to pity or peacefulness; there have been no such developments within animal understanding (other than mother love) except as between mates and the members of individual flocks and herds. Thus, crows will endeavor to rescue a brother of the wintertime congregation that has been injured by a falcon, owl, or gunner. Bobwhites, with a remarkable show of valor, will turn suddenly upon an enemy such as a cat, weasel, fox, hawk, or snake that has seized one of their number and, by swift, combined effort of beating wings into befuddled eyes, will sometimes liberate the unfortunate member of the covey. Wild goats and certain species of larger deer, such as the wapiti, caribou, sambur, and some of the powerful African forms, savagely attack *en masse* when one of their number is threatened by an enemy other than the larger carnivora. Whatever apparent sentiment of sympathy is shown by male creatures for the females is, however, protective and ingratiating; at other than breeding periods it may be quite wanting or even turned to violent bullying.

IN regard to animal happiness, it is very true that many creatures show a disposition to play, and therefore exhibit something akin to enjoyment—especially the young when well fed and protected. Of this the cubs of the larger carnivora are extreme examples, and even among adult species which live in constant fear of enemies, as do all the smaller forms which are commonly preyed upon, there is a tendency to caper and ignore conditional vicissitudes, but never is there a prolonged forgetfulness of danger. Those animals which are well holed up and thus free from attack, and the larger carnivora and ungulates that have no enemies in the sense commonly understood, may often know relative degrees of comfort, but there are not to be forgotten those pests that constantly annoy them: fleas, lice, mites that are kept active by the body heat of their hosts in winter, the tremendously numerous winged pests of warm weather, together with the not unfrequent effects of disease from internal parasites, thus making life rather a constant irritation.

I once watched two bears in file pass down a rock ledge perhaps an eighth of a mile long and devoid of vegetation, and in that distance they stopped to scratch themselves more than a dozen times. This was high in the mountains of Mexico where the temperature was anything but encouraging to insect life. I have seen a gray fox do much the same in midwinter. All animals, from mice to moose, are subjected to pests: it is impossible to imagine that anything approaching comparative comfort can be experienced under such circumstances.

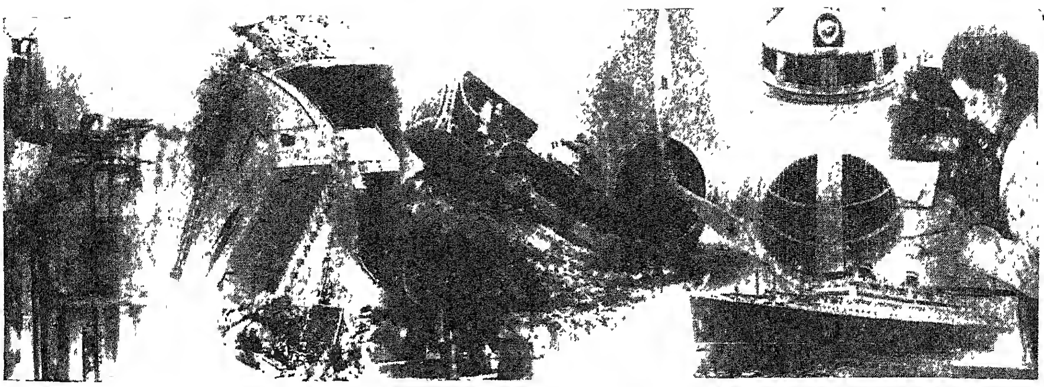
A walnut web-worm caterpillar (Datana) followed by parasitic tachina flies and an ichneumon wasp seeking to lay their eggs in the well-fed living host's body

The smaller quadrupeds, especially the rodents and the birds, know that the chief cause of discomfort is the dodging of enemies. Not that these creatures are beset by worry, as would be cogitating humans if constantly menaced, but the fact that they are conscious of danger becomes evident by their being always on the lookout. Observe a rabbit, or a terrestrial species of bird, while feeding. Double the effort is put into being aware of the possible approach of foes that is expended in getting food. But the mortality of the helpless young—and this also applies to many larger creatures that are preyed upon—is an astonishing percentage when investigated. Consider the number of nests in and around the average farm acres and note the numbers of helpless young destroyed in one way or another, mostly by carnivores, wild and domestic—the latter often exceeding in numbers the wild species that existed before the advent of man and his pets, thus often interfering with the balance of nature. Irresponsible man, too, often upsets the balance of nature.

It is the lower forms of life, so-called, including the vast number of insects and their relatives, that furnish the most complete argument against the idea of nature as a gentle mother. It is this vast group, commonly the victims of birds, moles, shrews, mice, snakes, toads, frogs, and lizards (also constantly at war with each other) that present to the nature student the most horrible examples of torture and death-dealing by slow maceration, dislocations, poisons, starvation, and what not.

Of all animals the hunted creatures greatly outnumber, both as species and individuals, those that seek their prey. Were this otherwise, the killers would find it far more difficult to obtain food. It is the very exceeding proliferation of the hunted creatures that maintains the balance between them and their natural foes. The carnivora do not obtain food as easily as is commonly supposed; there are a good many hungry stomachs among them at all seasons. The vegetable eaters obtain their food far more easily than the flesh eaters, though the latter vary their diet with succulent roots, twigs, seeds, nuts, and grasses in winter, and at all times most of the rodents, such as mice, wood rats, squirrels, and marmots, feed on insects in the grub and larval condition and eat defunct animal matter wherever they can get it. In winter those creatures that hibernate possess a very great advantage, in that they are out of reach.

PARASITISM is the most gruesome and horrible aspect of the struggle for existence, and one of the most effective agencies of limiting the individuals of many forms of life. I have in one season collected over 40 cocoons of moths, large and small, and every specimen hatched parasites alone. At another time nearly 30 cocoons brought forth only two perfect moths. Out of more than a baker's dozen of tomato worms, but three were free from the tiny apenteles larvae that crowded the interior of the worms' bodies. Such very common instances among hundreds of species are the extreme examples of the struggle for existence, for in such types there is no possible defense.



# THE SCIENTIFIC AMERICAN DIGEST

Conducted by F. D. McHUGH

Contributing Editors

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D. H. KILLEFFER
Chemical Engineer

## "Plug-in" Instruments to Aid Industrial Use

INDUSTRIAL plants will particularly benefit by the newly developed plug-in instrument in which a self-supporting socket can be mounted directly in the wiring conduit with a 35 percent saving over a conventional installation, according to Westinghouse engineers. Industries powered by individual drive, such as the machine and textile industries, will find this development of benefit since it makes practical the low cost use of instruments to act as guides for "production speed *vs.* machine life."

Plug-in meter and socket

With four years' development behind it, the present universal socket will give any desired load conditions by merely plugging in an ammeter, voltmeter, watthour meter, etc., one after another in the same socket. Standard "troughs" (all-metal boxes), with several sockets, will be used when more than one instrument is to be read at the same time, and can be mounted much like a motor starter. Quick and easy mounting has been worked out for ordinary wiring, such as rigid conduit, open wiring, or cable.

## Cancer Situation Far From Alarming

AN optimistic view of the cancer situation is taken by Dr. Louis I. Dublin, third vice-president and statistician of the Metropolitan Life Insurance Company. In a recent [illegible] to the *American Journal of Cancer*, quoted by *Science Service*, Dr. Dublin says:

"The cancer situation in the United States is far from alarming although much can be done to improve it. Encouraging are increases in research, education, and facilities for diagnosis and treatment. In three years, the American College of Surgeons registered almost 25,000 persons cured of cancer. Large numbers of physicians are being especially trained to diagnose and treat cancer more effectively. There are already about 200 cancer centers throughout the country which meet the standards of equipment and personnel established by the American College of Surgeons."

The increase in the cancer death rate during the quarter century from 1911 to 1935 is largely spurious, in Dr. Dublin's opinion. Previous to this period, just as many persons probably died of cancer but it was not recognized. The rise in the cancer death rate is almost entirely limited to men over 55 years of age, and especially white men. Cancer in men in four fifths of the cases occurs in inaccessible sites and could not have been recognized and diagnosed with methods used 25 years ago. This accounts for the rise in the male death rate from cancer which makes up most of the increase in the general death rate.

**TIRES**

**THE average motorist's tire bill during 1937 will be less than 8 percent of the car owner's expenditures for tires 30 years ago, or about 15 dollars.**

## Alcohol Blends *Do* Produce Carbon Monoxide

ONE of the claims put forward for blending ethyl alcohol with gasoline for motor fuel use has been that the blend produces less carbon monoxide in the exhaust [illegible] This question has been carefully investigated under a wide range of conditions at Yale University and the results recently reported show that the proportion of carbon monoxide in the engine exhaust is entirely a matter of carbureter adjustment and is quite independent of the fuel used. The elimination of carbon monoxide from the exhaust of an engine requires that more air be provided than is needed for complete combustion, whether the fuel is gasoline or a blend. This amount of air is excessive and when so adjusted, the performance and efficiency of the engine is impaired. When adjusted for best performance, the output of carbon monoxide is practically identical whatever fuel may be burned. Experiments made in this investigation included gasoline and blends containing 10 and 20 percent of alcohol respectively.—*D. H. K.*

## Safe, Silent, Personal Electric Fan

A PERSONAL breezemaker with rubber blades so soft they can't injure even a baby's fingers has been developed by the Samson United Corporation. And this Safe-flex All-Purpose model can be used "where" and "how" no other fans have been used before. This "little acrobat" actually pins up on walls—stands anywhere—clamps any place—and you can stick your fingers into it if you want to.

The clamp-on feature is taken care of by a steel clamp concealed in the mar-proof base of the fan, while a special pin is provided to utilize the fan in a pin-up position.

This small electric fan for person-

Furthermore, the ball and socket joint permits adjustment for every position.

Being portable, it means that a person can now carry his own private breeze with him. Besides, it is light enough to be picked up by a tot, yet laboratory tests and commercial applications show that its air displacement matches any eight-inch desk fan. Although the blades are constructed of flexible, moulded rubber, the shape and pitch keep them rigid. Added to its feature of safety, this all-purpose fan is actually silent.

**DIAMONDS**

**NUMEROUS industrial diamond chips, mounted in the rim of a cutting wheel by a special Belgian process, enable the wheel to cut through such hard rocks as chert and jasper as a knife cuts through butter. The wheel revolves at 4000 revolutions a minute and is used in the diamond mines on the Rand in South Africa.**

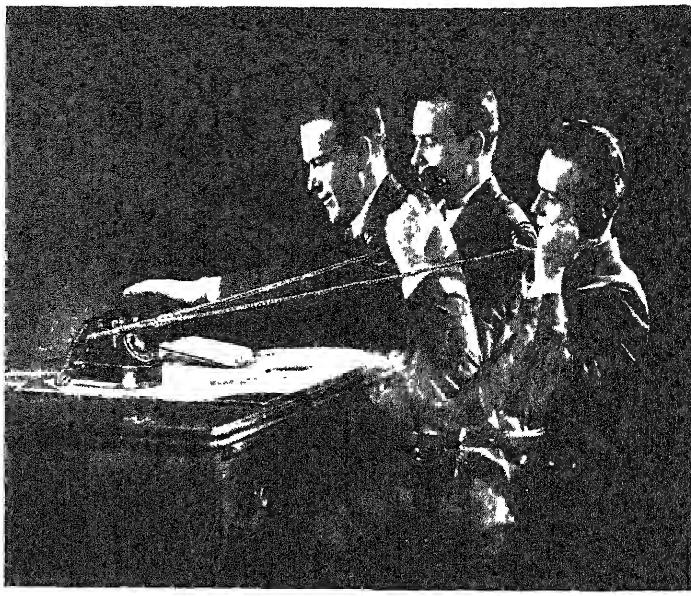
## At Last—A Kinkless 'Phone Cord

FOR many years, telephone users have sensed the need for a hand-set cord that "knows its place and keeps it"—one that can be relied on to extend to full length when occasion requires, and yet will not curl around an ink-stand or drag papers to the floor as it trails across the desk.

Many and weird are the contraptions that inventors have devised to overcome these faults of the common cord. With most of them, unfortunately, the remedy has been worse than the disease. They have either had wire springs that sooner or later cut into the braid, or mechanisms that give more trouble than they save, or the cords have been so made that they work with reasonable satisfaction for a time, but soon deteriorate to a point where they are about useless.

In the accompanying illustrations, we show a new telephone cord which has none of these defects. This is the Extensicord—the Automatic Electric extensible cord.

Its construction is unique, but quite simple. The several insulated conductors, instead of being laid parallel and covered with a common braid, as with the conventional cord, are braided to each other around a braid-covered elastic strand as a central core. The cord is assembled on a specially designed braiding machine. When it leaves the machine the ends of the conductors are secured together, leaving the



Kinkless 'phone cord in use, and, *at left*, in its normal shortened form

cord to assume a compact, contracted form—less than half of its fully extended length.

When the telephone is not in use, the cord has no chance to stray from the telephone to get entangled with papers or desk paraphernalia. When the user reaches for the hand unit, the cord stretches easily in a smooth, straight line while the user assumes a comfortable talking position. When the hand unit is replaced, the cord contracts instantly and smoothly to its normal shortened form.

## Factory-Built, Even to the Doorbell!

BUILT complete, decorated, and ready to move into, a full-size, five-room, electrically-welded, steel house, with garage incorporated, was mounted on a semi-trailer and rolled out of the R. G. Le Tourneau grading machinery plant at Peoria, Illinois, recently.

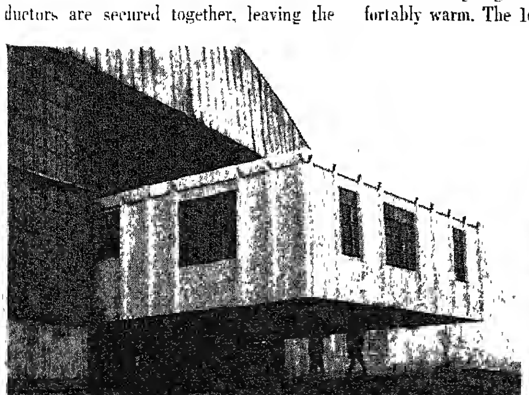
There was coal in the two-ton hopper, the furnace was going and the house was comfortably warm. The 16-wheel trailer, towed out of the factory by a Caterpillar tractor and along the roadway by a $1\frac{1}{2}$-ton truck, had no trouble with its 41-ton load.

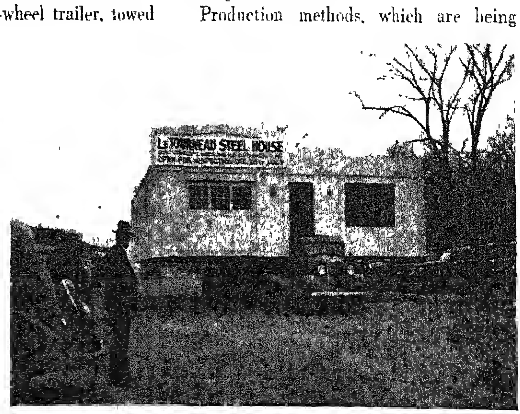
On a space leveled off in the front factory yard, just as a homesite would be leveled, the 32 by 44-foot house was gently set down by a tractor crane which took hold of the three steel rings on the roof, lifting it while the trailer rolled out from under. Within a few hours, water, sewer, and electric connections were made, drapes were up, floors carpeted, each room appropriately furnished, and the house was ready for occupancy.

This house is the first of a number of similar cottages for employes that are to be built complete inside the factory. When the next five houses—on which construction has started—are finished, the six dwellings are to be launched on the Illinois River, which flows past the factory, and towed on their own bottoms across to a Le Tourneau colony site.

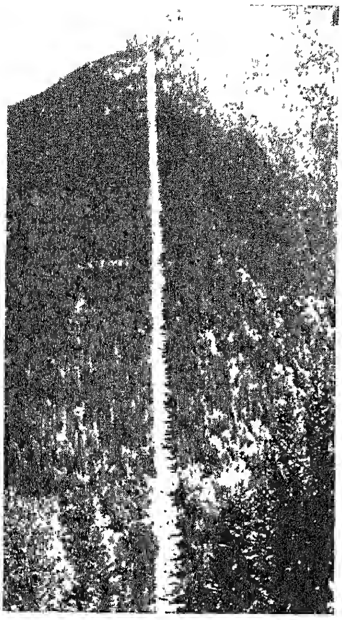
These are believed to be the first all-steel houses ever built, as well as the first houses to be completed, ready for occupancy, inside a factory. The first house has asbestos board ceilings and living room walls, and wooden doors, but the dwellings now under construction and all future houses are to be entirely steel except for plumbing fixtures and rock wool insulation between the wall sheathings and between ceiling and roof.

Production methods, which are being





# TRANSPORTATION SECTION



We publish this picture not because it is just a pretty picture. It isn't even unique. It does, however, serve to symbolize the friendly relations between Canada and the United States, for this is a part of America's northern border. Europeans may take note that this 20-foot clearing tract is merely a marker and not in any sense of the word a path for military sentinels or transportation

perfected on the five houses now building, will permit completing future houses with the economy, precision, and speed employed in manufacturing scrapers and other equipment. It is estimated that with present available space and facilities one house can be finished every three weeks.

Although this steel house, proposed and outlined by R. G. Le Tourneau and designed by Architect Ephraim Field, is a mobile house, it is certainly not in the class of any so-called portable house or any prefabricated house. The purpose in planning it was to provide Le Tourneau employes with a complete, convenient, and attractive house of about average size that could rent or sell at a moderate price. It is designed to utilize every foot of space and thereby afford with a modest ground area a five-room house with rooms of generous size.

The built-in garage or utility room, with overhead door, also houses the heating and cooling plant and the laundry. It is quite livable enough to be used as a party room winter or summer.

When they are on the market in a variety of styles and sizes with models changing as architectural fashions shift and advance, the builders suggest that an owner should be able to trade in his house from time to time for a newer or larger model to accommodate increasing family and income.

## Cabooses

TRAIN crews on the Chicago, Milwaukee, St. Paul and Pacific Railroad have been taken down off their high seats in the cabooses on that road. The cupola, long a familiar sight on the last car of freight trains on all railroads, has been removed and trainmen have been given instead projecting cabs at the sides of the caboose from which they may view the train ahead. This change is partly due to the fact that higher box cars have lately so obscured the view of trainmen that brakemen had to crane their necks to watch the train ahead to see that the long line of swaying cars functions properly.

The Milwaukee road is rebuilding in its shops in Milwaukee its fleet of 900 cabooses and besides making the change above noted are modernizing them in other respects.

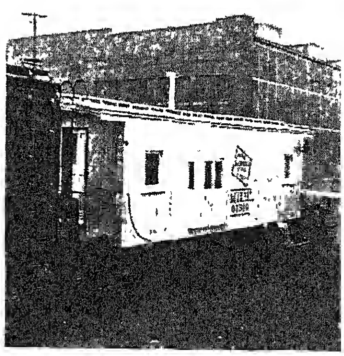
Trainmen seated in a remodeled caboose more easily inspect a train for dragging brake beams or truck parts. Also they readily detect hot journals since the odor arising from burning oil-soaked waste, used for lubricating journals, usually hangs close to the ground. There is an added safety feature since trainmen no longer are required to climb in and out of a cupola.

Removal of the cupola has permitted removal of partitions inside the car, making a roomier, more airy and more readily heated caboose.

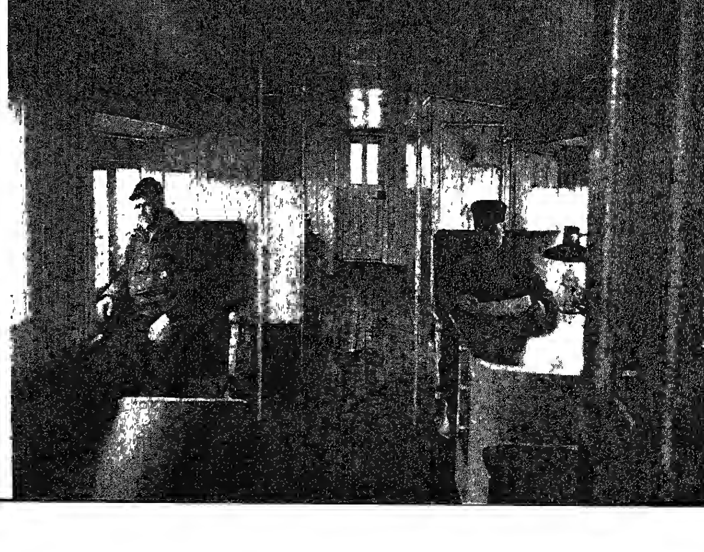
Side seats six feet long, upholstered in leather, are built in and used by trainmen to make into beds during the time they are at terminals away from their home stations. Standard type coach seats are provided in the side bays, permitting trainmen to assume a comfortable position while watching the operation of the train.

Toilet facilities are provided, as well as washstand with water supply. There is a built-in refrigerator for storage of food and also a tool locker.

The exterior is finished with aluminum paint; the running gear, platforms, handles and ladders are finished in black.



*Above:* The new caboose, *sans* cupola and with "bay windows." *Below:* Interior of the caboose, showing the comfortable position of the trainman watching his long line of freight cars



### ALUMINUM ROADS

**OFFERING the advantages of corrosion-resistance, prevention of softening of the road in hot weather, and high visibility at night, aluminum roads have been developed in Germany. To construct these, powdered aluminum is mixed with the usual surface material of tar or asphalt.**

## Correction—Union Pacific Trains

FROM Professor Edward C. Schmidt, Railway Engineering Department, University of Illinois, the Editor has just received the following letter. We gladly publish it in order to keep the record straight.

"I am sorry to find that in the article entitled 'More Efficient Locomotives' which I prepared for your April issue, I have on page 225 twice referred to the first of the Union Pacific Railroad high-speed trains as being provided with Diesel engines. This is not correct. The motive power for the first Union Pacific train was obtained from a 12-cylinder V-type distillate-burning engine rated at 600 horsepower. All subsequent high-speed trains on the Union Pacific were provided with Diesel engines."

## No More Oil Cans

LOCOMOTIVE engineers and oil cans have been inseparable since steam railroading began. But the tradition has been broken by the new Mallets of the Norfolk & Western, says *American Machinist.* All

bearings that take oil are supplied by a pump from a central reservoir on the side of the locomotive. Oil supply to each bearing is metered by the usual control of the opening at the bearing. The engineer still has the oil can but no place to use it.

### U. S. CARS

A NEW all-time high for motor vehicle registration was made in 1936. Registrations in the United States in 1936 totaled 28,221,291, of which 24,197,685 were passenger vehicles and 4,023,606 trucks and tractor-trucks.

## Erosion Control Measures on Highway

EROSION control measures developed for farm lands will be used to protect sections of state and federal-aid highways this year under plans now being worked out between 19 state highway departments, the Bureau of Public Roads, and the Soil Conservation Service, the United States Department of Agriculture announced recently.

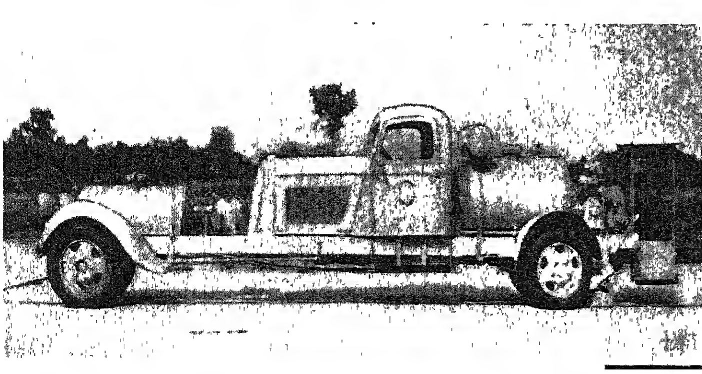
A recent survey in Wisconsin showed erosion responsible for much of the cost of highway maintenance in certain parts of that state. Uncontrolled soil erosion also increases maintenance costs on federal-aid roads, according to officials of the Bureau of Public Roads.

Under the proposed program, state and federal officials will select short stretches of right-of-way along highways within the boundaries of Soil Conservation Service areas. The Service will furnish technical supervision, labor, and necessary planting materials. The state will supply construction material and equipment, and agree to maintain the work for five years.

Actual operations to protect highway cuts and fills, highway ditches, and drainage structures, have been started in some of the 19 states, says H. H. Bennett, Chief of the Soil Conservation Service. Vegetative control measures will be used wherever possible, although some construction work will be done where gullies are menacing adjacent farm lands.

## To Mark the Nation's Highways

WITH a wheelbase of 24 feet but measuring only a yard between each pair of tires, fore and aft, is the newest type of highway marking truck shown in our illustration. By use of a triangular sight mounted on the front end, and aided by the excessive length of the vehicle, the driver can lay down a painted stripe in the exact center of the roadway without any preliminary marking. The driver, amidships, looks through the triangle that takes in a section of the entire road ahead of the truck. A vertical line on the sight tells him the center. Actual painting is done in the rear by an operator seated in the small cab, who is equipped with a two-way electric signal to the driver. Up to three lines can be marked at once and from 40 to 50 miles covered in a day at a cost of about 15 dollars a mile.—*Science Service.*



## Motor Trucks and New Fuels

IN her attempt to attain self-sufficiency, Germany is turning to several domestic products for power for her larger motor vehicles. At the recent 1937 International Automobile Exposition in Berlin many of the exhibitions of carbureter motors bore this legend—"This car can be run on illuminating gas, or gasoline, or wood gas."

Benzine is being rapidly abandoned in favor of domestic products. The powerful and efficient Diesel motor is, of course, by far the most used in the building of trucks and buses, and it is here that Diesel oil has frequently been replaced by some form of domestic fuel.

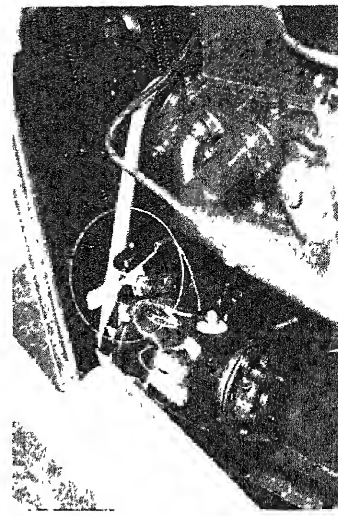
The electric motor vehicle which for many years has been in the background has again made its appearance. In addition to small electrically propelled delivery carts and wagons, there are also four- and five-ton trucks and tractors run with electric motors

Many buses in Berlin are being operated on ordinary illuminating gas, large compression tanks being installed on the buses to carry a supply of fuel. Since, however, they can carry no great quantity, two gas-tank cars (portable filling stations) have been put into service to follow up the buses and replenish their supply. It is said that city gas is now saving Germany something like 750,000 liters of benzine daily which otherwise would have to be imported.

The use of gas derived from wood as fuel is making much headway. Already something like 2000 buses in Germany are being driven on this form of fuel.

## Horn for High Speed Driving

LOUD automobile horns in city streets have become so annoying that many cities have carried on anti-noise campaigns for months in the attempt to silence them. In this day of high speed, however, a horn of penetrating tone is necessary on the open highway and when that same horn must be used during low-speed driving in the city the result is only what might be expected.



*In circle:* Air-operated switch that cuts-in a high-speed driving horn

This problem has been attacked and solved most ingeniously by the Delco-Remy Division of General Motors Corporation. They have developed a horn of great penetrating power for high-speed driving only. It is expected that the car owner will use a separate horn of low pitch for ordinary city driving but when he hits the open road, the Klaxon Penetone will automatically cut in. Therein lies the trick.

The Klaxon Penetone is connected to an air switch which is mounted beneath the hood at any convenient location near the front of the engine. On this air switch is a cupped air vane, the cupped side of which faces forward just behind the fan. As the speed of the car increases, the increased flow of air swings this cupped vane to cut-in automatically the Penetone so that its stronger signal may be heard for long distances on the open highway.

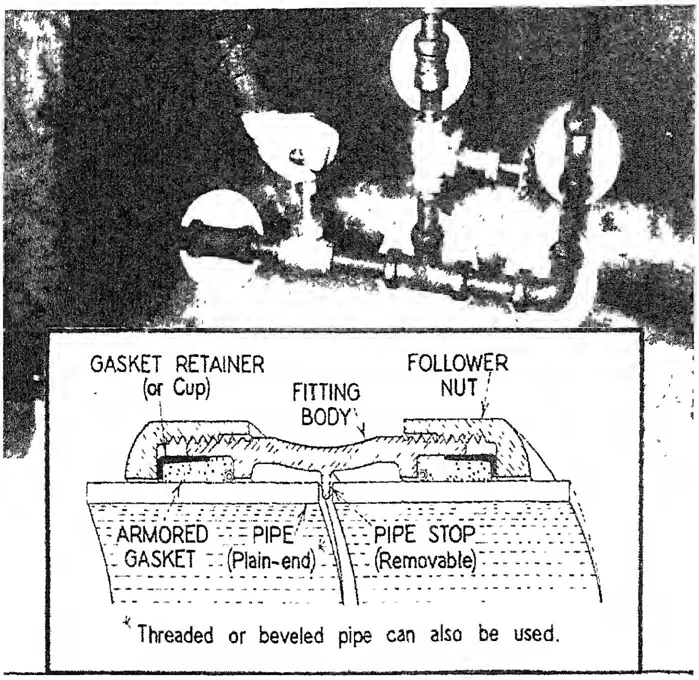
## Locomotives Run Backwards

THE conventional locomotive is likely to get stuck in snow under a snowshed and almost suffocate both the engineer and the fire. So, reports *Power*, Baldwin is building big Mallet-type locomotives to run backwards. The cab is where it ought to be, but the smokebox and the stack are connected to the tender. Control levers are put in a stand in front of the operator, and what should be the back of the cab is glassed shut. The bell comes down off the smokebox and goes under the cab with the headlight.

## Women Drivers

SCIENCE has come to the defense of the woman driver. If she is not so efficient as are the men, it is not because of her sex or innate abilities but merely because she lacks driving experience.

This is shown by tests, reported by *Science Service*, of more than 2000 persons on vision, reaction time, and other essential abilities for the automobile driver, made by Dr. A. R. Lauer, associate professor of psy-




Threadless pipe couplings, and, *in drawing*, how they are used

Only in strength of grip was there any difference between the sexes. Among the younger persons tested, the men were somewhat better than the women in judging distance. Women were somewhat inferior in tests of performance of skills resembling auto driving, due to the lack of experience of those tested.

The best drivers are those 22 years old, Dr. Lauer reported to the American Association for the Advancement of Science. This is true of both men and women. In complex mechanical skills, boys and girls are about equal up to the age of 15. After that, the boys are superior, but this difference disappears again in later age.

Keenness of vision drops off rather sharply for both sexes after the age of 40 to 45, and after 55 the loss is still greater. Ability to stand glare begins to lessen at the age of 20, and the drop is much sharper after 40.

In making these tests, Dr. Lauer transported his driving clinic about like a circus, making two-day stands in each town and inviting the general public to come and be measured.

"It was very strongly emphasized that the studies were experimental and that no definite statement could be made regarding a single driver—no more than a doctor could guarantee a certain life span by a physical examination," Dr. Lauer said. "One can tell that the individual has certain characteristics which need treatment, or which should pre-dispose the person to live to a ripe old age, but he cannot be assured that the person will live such length of time."

*(End of Transportation Section)*

## Light-Weight Concrete Aggregate

OVER 30,000,000 pounds of dead-weight were saved in building the San Francisco-Oakland Bay Bridge by the use of a new light-weight concrete. The lightness of this concrete was made possible by the use of a new aggregate called Gravelite.

The upper deck of this bridge is a con-sion joints) of reinforced Gravelite concrete six inches thick, 60 feet wide, and extending the entire length of both the western and eastern bay crossings of the bridge, a distance of 4¾ miles. This slab of light-weight concrete contains 28,000 cubic yards, and weighs 15,000 tons less than the same slab would weigh if made of ordinary concrete.

Gravelite weighs only half as much as the ordinary sand and gravel it replaces. It is made by burning particles of clay and shale in such a manner as to cause them to expand into a light material of unusual strength.

In manufacturing Gravelite, the clay is mined and ground, mixed with enough water to make it plastic, and then forced through hardened steel dies under high pressure, these dies having holes of sizes corresponding to the sizes desired in the finished aggregate. As the pencils of clay are forced through these holes, they are cut off by rapidly rotating wires, producing small cylinders of clay. These cylinders are then introduced into a rotating kiln, where they are subjected to a high temperature, which causes them to expand to more than twice their original size. This expansion of the particles of Gravelite imparts lightness to the concrete, and heat-insulating properties that are said to be four times greater than for ordinary concrete. The high crack-resistance of the concrete results from the fact that the particles of Gravelite are more resilient than sand or rock.

After being burned, the Gravelite is stored in large piles, and, before being shipped, it is separated as to size, so that the user will receive accurately-sized particles in accordance with his requirements.

## Pipe Threading Eliminated by Standard Fittings

"TIME OUT" for cutting pipe to exact lengths, threading, grooving, flaring, or screwing up joints in cramped quarters, is not necessary with the standard line of Dresser Style 65 Fittings just announced by the S. R. Dresser Manufacturing Company. Nothing but an ordinary wrench is needed to complete a joint in a few moments.

After inserting the plain-end pipe into the fitting, which comes completely assembled, it is only necessary to tighten two threaded octagonal follower nuts with a few quick turns of the wrench. As this is done, resilient "armored" gaskets at each end of the fitting are compressed tightly around the pipe, forming a positive seal. The resulting joint is claimed to be not only permanently tight but to absorb normal vibration, expansion and contraction movement, and permit deflections of the pipe in the joint. If the pipe is already threaded, it can also be joined in the same way.

The complete line of fittings includes standard and extra-long couplings, ells (both 45 degrees and 90 degrees), and tees, all supplied in standard steel pipe sizes from ½-inch to two-inch inside diameter, inclusive, black or galvanized.

These fittings are recommended by the manufacturer for joint-making and repair work on both inside and outside piping, for oil, gas, water, air, or other industrial lines.

## Tear Gas as Fumigant

CHLORPICRIN, an effective tear gas used in the World War, is finding increasing use as a disinfectant and fumigant. Methods of application have been developed which make the residue of the material easily removable. Chlorpicrin has been found to kill the clothes louse and its eggs in a half hour when applied to clothing in a galvanized iron container which is slightly

warmed, using 4 cc. per cubic foot at 80 degrees, Fahrenheit, or higher. A subsequent five minute airing period allows the clothing to be worn at once.

Other uses for chlorpicrin are based on its high toxicity, remarkable penetration, and definite germicidal and fungicidal properties. Its tear-producing qualities are valuable to prevent poisoning of workmen, since even in non-dangerous concentrations it produces floods of tears. It does not affect textiles, furs or colors, and it has no explosion hazards.—*D. H. K.*

**BOOTS**

**BECAUSE boots are being made by a rubber factory in Liverpool, England, for sheep does not mean that the sheep are sissies. According to *Business Week*, they are supposed to protect the animals against "foot rot."**

## Athletes No More "Red-Blooded" Than Average Men

THE idea that strong men and athletes are more "red-blooded" than the average man may provide good reading in a dime novel but as far as scientific confirmation goes—well, there just isn't any. Nor is there any evidence to support the popular conception that a champion athlete has bigger lungs than the average man. With ordinary-sized lungs, however, he can handle half again as much oxygen as the average man.

Research by Dr. David B. Dill of Harvard's Fatigue Laboratory, reported to the American Association of Physical Anthropologists, shows that hemoglobin, the red coloring matter of blood used for transporting oxygen, is just as concentrated in the arteries of the average man as it is in those of the superman.

Dr. Dill also exploded the myth that man must "alkalize" or stay on the alkaline side. "If we are to believe current advertising slogans," he said, "a considerable fraction of our population is in need of additional alkali. Sodium bicarbonate or more expensive substitutes will open the door to strength and health, we are told. So far as our observations go, well-nourished boys and men seldom need more acid or alkali than is found in their foods. The regulatory function of the lungs and of the kidneys maintains an extraordinary nicety of balance. The capacity appears to be fully developed in the adolescent."—*Science Service.*

## Research on Marble

DESPITE the commonly asserted backwardness of the building industry toward research and development, the industry does move forward. Less spectacularly perhaps than others, material manufacturers' researches occur in unsuspected places. The makers of synthetic products would seem to enjoy special advantages here since their product or method of manufacture may be improved in endless ways. But some of man's oldest construction materials, such as lumber and stone, are not made. As handicapped members of an assertedly backward group, producers of such materials

position. It is therefore refreshing to take note of research concerning one of man's oldest building materials—stone.

The Vermont Marble Company, long skilled in the art of extracting, cutting, and polishing one of nature's more beautiful stones, has accepted the challenge to research concerning the product itself.

Noteworthy is the amount of fundamental research carried on by the company in petrology and the micro-structure of stone. It has been learned that interlocking crystals favor durability, that the size and orientation of the crystals also play a significant rôle. Weathering characteristics are improved when stone cutting is guided by the knowledge of such details. The effect of different fabrication processes is being studied. When and how surface flow occurs in polishing, and the width and distribution of the extremely narrow spaces between the crystals are topics of investigation.

Such research has led to three relatively new products. Newest of these is "Markwa"—marble in tile sizes and form. This development is made possible by the use of new equipment to reduce the cost of thin cutting. The beauty and natural delicacy of these tile seem to promise stern competition to the present tile field.

More intimately concerned with fundamental research is "Lumar," the new translucent marble. This product is an attempt to provide not only a translucent marble but one with high diffusion while still retaining the life and sparkle associated with marble. Here the crystal orientation, composition, size, and spacing are of first importance. The fact that each minute calcite grain has optical properties dependent on direction enormously complicates the problem. As would be expected, most marbles do not conform to the rigid requirements and severe stock selection before cutting is necessary.

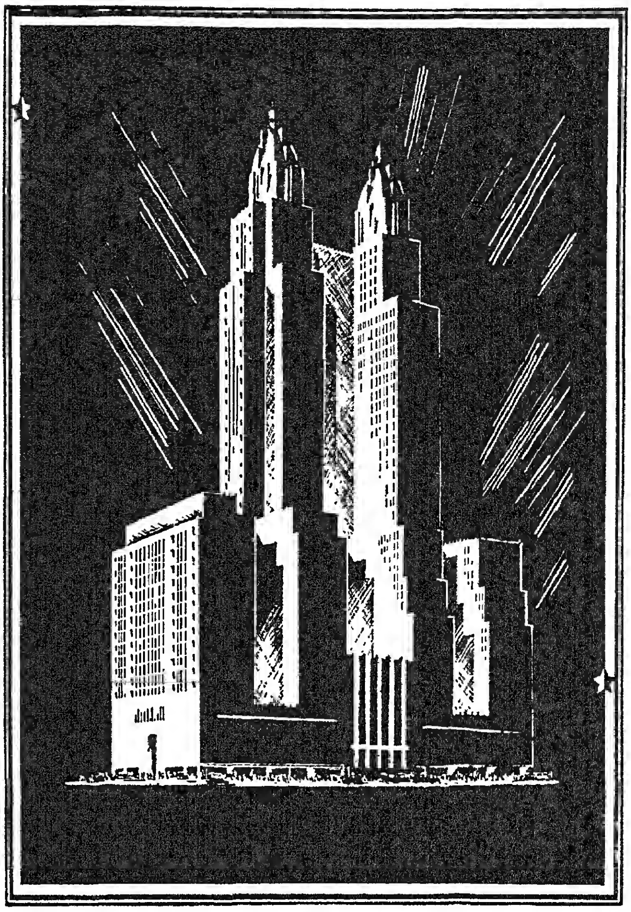
Black marbles have not been common in this country and the demand has been met by importation. Through an undisclosed process of interfusion, the Vermont technologists have developed a jet black marble, known commercially as "Jetmar."

These are examples of the way many building material manufacturers are quietly pushing their research. Unfortunately there is still little evidence that those who assemble these materials into buildings have any similar interest in fundamentals. Thus we must still cope with leaky flashings of high-grade metal and poor masonry walls of apparently good mortar and stone. It is the duty of the maker of the stone and mortar to produce a good wall but only other types of wall will force him to do so.

More information may be secured from Mellon Institute, Pittsburgh, Pennsylvania, where the Vermont Marble Company is sustaining broad basic research, resulting so far in the new products described above.

## Lightning Hazards in Golf

THE golfer caught in a thunderstorm with its accompanying lightning is no more in danger than are farmers and other persons who make their living in rural communities. Although death by lightning is one of the rarer forms of accident death, the city dwellers of the nation are, as a rule, safer than their agricultural brethren



lightning kills less than 400 people a year, based on figures for a 10-year average. The chances of being killed by lightning are only a few parts in a million at the worst. On the Pacific coast they are as low as two in ten million.

Habits in part account for a slightly increased hazard from lightning in the open and the golfer suffers from the common tendency to get out of the rain when a thunderstorm comes. His first impulse is to seek protection from the rain under the nearest large tree. And if the tree is isolated, as it may very well be on a golf course, he is standing under a favored spot for a lightning stroke. If the tree is in a fairly dense woods the chances of it being hit are much less.

If the golf course is fairly level and the golfer is caught in the open without protection he himself forms an isolated target for a possible lightning stroke. If he continues to play in the rain and persists in swinging his steel-shafted golf clubs over his head, he is adding still another small factor to his chances of being struck.

Without protection from a nearby wood or club-house, the golfer in the open would do well to stay in the small depressions on the course and off the higher knolls.

—*Science Service*

## Germicides from Petroleum

In refining petroleum to make transformer oil, certain complex nitrogen compounds have been recovered. Ordinarily these are left in the tarry oil which is discarded. Recent investigations at the University of Texas show that some of these compounds are efficient germicides. It is possible that within the near future this large waste of petroleum refining may become valuable as a source of pharmaceutically useful materials.—*D. H. K.*

## Centuries of Inter-marriage

Intermarriage for several generations is popularly supposed to weaken the stock and produce a race of people physically and mentally degenerate. Evidence to the contrary appears in a report to the American Medical Association of a study of conditions in the small fishing village of Usuki on the coast of western Japan. The inhabitants of this village have strictly kept the custom of intermarriage for hundreds of years.

According to tradition, the village was settled in 1605 by the descendants of a noble family forced to flee in a civil war. The biologic effect of intermarriage has been studied in the village since 1933 by Dr. Takeshi Ikemi. His findings are summarized in the following report:

"There are 135 families having 1786 members in all (904 males and 882 females). They have never mingled with other villagers or townsmen except in business transactions; consequently their habits and customs are quite different from other Japanese.

"Although the children are not regular attendants at school, an investigation of the school records shows that they generally do well at school. Thus intermarriage never affected their intellectual faculties.

"Crime is rare. The sanitary knowledge of the people is meager; they have epidemic there is never any serious hereditary disease. Leprosy, syphilis, and elephantiasis at present are not seen among them. Neither color blindness nor insanity occurs. The constitution of the people is strong and they are good wrestlers in spite of their taking very simple food. In the physical examination for conscription, these villagers have always ranked first, in that prefecture, with respect to health and constitution.

"Divorce is rare. The birth rate, in comparison with that of the two neighboring villages, shows that intermarriage does not affect the birth rate. Still births are uncommon.

"There are now 27 couples who married cousins."

Information about the offsprings of these couples shows that "when the excellent are married, no bad results are to be found."

—*Science Service*

**SKINS**

**Once 25 cents would purchase a muskrat skin in prime condition, but now they bring two dollars each. Muskrats support a business of 2,000,000 dollars a year in the state of Maryland alone.**

## Luminous Paint

A new luminous paint of Swedish invention, claimed to have a brightness similar to a neon light, will soon be put on the market here. Considerably cheaper to manufacture, the "Swedish Radium Light," as it will be known, is a luminous radioactive paint, which will find wide use for instrument boards, signs, life-saving cabinets, as well as for marking emergency exits. The Swedish Admiralty and the Swedish State Railways are seriously considering its adoption.—*Holger Lundbergh.*

## Archeologists and Pot-Collectors, Amateur and Professional

On previous occasions, this magazine has taken a stand against circumstances which at present permit anyone to excavate for archeological finds and keep the finds. In France and elsewhere in Europe, such finds are rightly regarded as the property of the state—which in this instance means the property of science since the state there acts on behalf of science. We reprint a letter written by Ernst Harms and published in *The New York Times* bearing on this subject, but in doing so we point out that it is not amateur archeologists, as such, which we regard as "out of order," since trained amateurs can do and have done good work in archeology, but amateur and particularly professional "collectors" of irreplaceable archeological artifacts which are detached from their surroundings, sold as mere curios, and thus are lost to science. Mr. Harms' letter:

"I read in *The Times* report of the archeological meeting in Washington that 'Herbert F. Spinden called the mound-building area of the Mississippi Valley the "oldest and richest archeological area in the United States." However, its archeological value,' he noted, 'was being reduced by amateur

tural deposits in the pursuit of specimens for private collections.'

"The federal government and the individual states have in exemplary fashion taken care of valuable locations through founding parks and special territories. Meanwhile, archeological sites of equal value and far greater irreplaceability are left to the evils of arbitrariness and destruction. Some time ago, for instance, I learned how much damage was being done to the remains in Mimbres Valley, New Mexico. This spot is still of greater archeological value than the mound-buildings, because it is the birthplace of a unique prehistoric group of international importance.

"Laws have been passed in almost all European countries prohibiting amateur or commercial excavation and even providing for the disposition of finds and sites independent of the land owners involved. In several countries the laws go so far as to appropriate all archeological discoveries as state property. Buying and selling are forbidden unless the cultural departments give special permission.

"It is an urgent public need that the United States pass federal and state regulations to protect the archeological documents of America's past."

### RAISINS

PURCHASING power of the masses in China is so low that one American company found that it would have to package as few as five raisins in an envelope to capture the lowest unit of Chinese copper currency.

### New Cellulose Plastics

A NEW cellulose acetate, triacetyl cellulose, has been shown to have extraordinarily valuable properties as a plastic. Most important of these is the impermeability of a thin film of this material to water. The compound is prepared by the action of acetic anhydride on cellulose and when finished is stabilized by including about 0.02 percent of combined sulfuric acid. Films, foils, and rayon can be prepared without the addition of softening agents and have excellent properties for use in the electrical industries.—*D. H. K.*

### Cleaning Sprayed Cherries

ALTHOUGH cherries ordinarily hold less spray residue than other fruits, it is sometimes necessary to clean them before marketing in order to meet the stringent requirements of the law regarding arsenic and lead. The delicacy of cherries requires that the washing process be very carefully conducted to prevent damage in the form of split skins if the fruit is handled wet.

A procedure recommended by the New Jersey Agricultural Experiment Station consists in dipping the cherries already crated in baskets into a solution of 1 percent hydrochloric acid for 30 to 60 seconds and following this acid wash by two rinses in water. The hydrochloric acid solution is prepared by adding three gallons of 20° Baume acid to 97 gallons of water. This

# THE AMATEUR TELESCOPE MAKER

Conducted by **ALBERT G. INGALLS**

HERE is interesting news. Aluminizing brought one step nearer reach of the average amateur and at least within practical reach of groups. The compact data presented below were prepared by Prof. Henry L. Yeagley of the Department of Physics at the Pennsylvania State College, State College, Pa. For two years he has been teaching mirror making as a part of a college course in descriptive astronomy, is also an amateur telescope maker in his own right, and therefore rightfully belongs to our gang. Figure 1 shows the equipment he has developed, after two years of experimenting with the aim of cheapening the process for the amateur. A small sample mirror he sends us looks fine, yet he says he aluminized it from some pieces from a ten-cent aluminum pan, after merely washing it in Ivory soap and rinsing in distilled water. His description follows:

Figure 2 is a combination photograph drawing of the parts and assembly of an ideal evaporation chamber. The top and bottom consist of 1" glass plates *I*, strong enough for vacuum chambers up to 14" in diameter. The 1/4" cylindrical wall *K* may be of ordinary glass, Pyrex, or metal, such as brass or aluminum. In case metal is used, a concentric cylinder *J* is desirable, to receive the stray aluminum (easily removed with a copper sulfate hydrochloric acid solution). A large bottle with bottom removed, as suggested by John Strong in ATMA, serves adequately for either an inner or outer cylinder. If the outer cylinder is of this type it should be completely covered with a wire screen to prevent injury in case of an implosion.

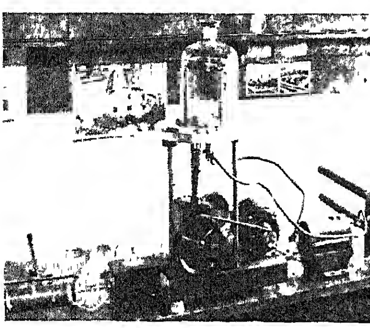


*Figure 1:* **The complete set-up**

Holes in the glass base are cut with Carbo and a rotating pipe. The use of these holes for sealing in the electrodes and exhaust port obviates the need for tricky glass-blown seals.

The operations entering into the making of the electrode parts *A*, *B*, *C*, and *D*, are ordinary metal turning, drilling and threading. The lead-in and low voltage connection *A* is turned and threaded to fit into the lower drilled and tapped portion *B*. The L-shaped members *C*, *C*, are bent from 1/4" brass rods and held in place in the drilled holes in the upper part of *B* by set screws. The horizontal portions have 1/16" holes and are slit lengthwise by a hacksaw. Rings *D*, *D*, with set screws, serve to clamp the filament wires in these jaws.

is also made on a lathe. The opening should be at least as large as that entering the Hyvac rotary pump, and the sides of the hole as smooth as possible, to facilitate the passage of air molecules. The metal walls should be at least 1/16" thick at every point and it is a good idea to cover the outside parts entirely with vacuum wax.

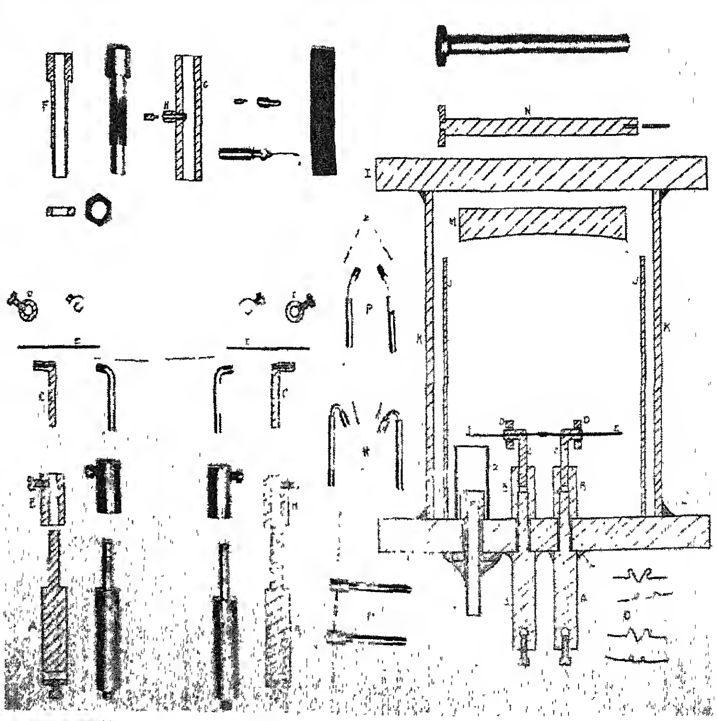
All joints, including metal-to-glass, metal-to-rubber, and glass-to-glass, are joined with vacuum wax, as indicated by cross-section at *L*. The method of applying the wax is shown in Figure 3: an electric soldering iron is held so that the vacuum wax may be melted and guided into place by it. Care should be taken not to flow the wax between surfaces, as in metallic soldering, since this prevents easy separation of the parts later. It is desirable to build up a good backing of wax around the electrodes and exhaust port joints, since they become slightly warm during the high voltage cleanup. This prevents an undesirable flow of the wax into the joint. If leaks are present after evacuation is started, the remedy is always the same; *i. e.*, simply warm the wax joints with the soldering iron until the leak ceases to exist. The writer has always succeeded in quickly healing leaks (which seldom occur) in making some 200 evaporations with this technic.

To open any of the seals the wax is easily scraped away with a wood chisel and penknife. To free the main cylinder entirely, after atmospheric pressure has been restored inside, force more air in through the release valve opening, either with the lungs or a small air pump, and then force a sharp wooden wedge under the cylinder-base plate joint. A slow, steady push is more desirable than strong-arm methods, for obvious reasons. The removed wax may be used over and over again.

The filament is of new, overlapping, adjustable type. The older type helical and sine wave filaments are costly and require hot winding and bending of the tungsten wire. The single V type will largely eliminate these features but often permits the molten aluminum bead to travel up one side and freeze. This effect is due to occasional greater heating on one side of the molten ball, which causes a relatively lower surface tension on that side, permitting it to be pulled up the opposite side in spite of weight.

The filament shown at *E* is somewhat similar to the electrode arrangement in a carbon arc light. Two straight pieces of tungsten wire are clamped in the holders *C*, *D*, so that they overlap 3/16" at the mid point between the electrodes. Three inches of .04" aluminum wire are carefully wound on this overlapping portion. When the current is established in the filament, the overlapping portion becomes welded immediately. Because of the greater cross-sectional area, less heat is formed here, resulting in a "cold spot" which causes the molten aluminum to hug this position tenaciously. If the aluminum is all boiled off of the filament after a run, the overlapping tips of tungsten should be sanded on the contacting sides and again sprung together. This is to insure low resistance and keep the local temperature low enough to maintain the aluminum ball in position.

Successive evaporations gradually amalgamate and weaken the tungsten wherever the molten aluminum is in direct contact



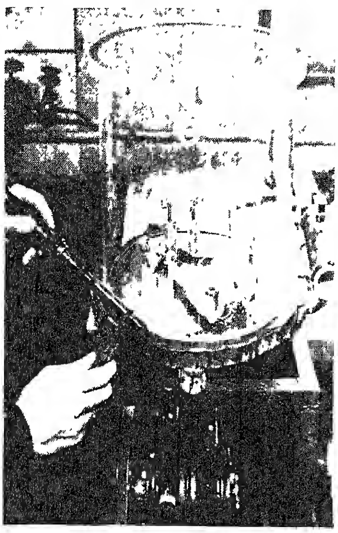


*Figure 3:* Applying wax

with it. After about 15 runs the filament will break during one of the cooling periods. The break always occurs on one side of the doubled portion, which is removed by breaking off the opposite side with tweezers. The remaining portions of wire are then released and moved toward the middle, to form a new filament. By this means a hundred or more runs may be made with two 3" pieces of tungsten. With the older types of filament a considerably greater portion of wire must be discarded when they become weakened by amalgamation. (*O* and *P*, Figure 2, may be ignored, being another type once used.)

The release valve *H* began life in the form of a hypodermic needle which was inserted through the rubber connecting tube *G* after each run. The same hole could be used and resealed with wax an indefinite number of times. Although this was an entirely satisfactory method, the valve *H* was evolved to take its place. The small plug, indicated in the illustration, is easily removed, reinserted and sealed as often as necessary. Either the hypodermic needle or brass valve will eliminate the need for costly and troublesome glass stopcocks.

The inverted position is best for aluminum coating small mirrors.

When mounted in the inverted position the mirror may be freed from lint and dust particles with very little danger of further contamination of this type. This insures freedom from "pin holes," provided also that the pre-cleaning by washing has been thorough. This position also eliminates the chance of molten aluminum falling on the mirror and melting a hole in its surface—an extremely remote but possible occurrence. The depth of coat is easily and accurately controlled by observing through the top edge of the disk, when the film becomes opaque.

The surfaces to be coated may be cleaned satisfactorily by scrubbing with Ivory soap and hot water for ten minutes. A soft cotton cloth makes a good wad for this purpose. Subsequent rinsing with distilled water, and firm rubbing with cotton or cotton cloth, assure a surface conditioned to take an extremely adherent coat of aluminum.

A Cenco Hyvac rotary oil pump, connected to the vacuum chamber by a short piece of large diameter rubber pressure

sure if leaks are absent. About 3" of ¼" walled, ⅜" inside diameter pressure tubing is desirable. The oil in the pump should be renewed after about 15 runs. No. 30 Quaker State Oil is excellent for this work.

The necessary low pressure is indicated when 5000 volts across the exhaust port filament space ceases to produce a visible discharge when viewed in the dark. This latter is true when the distance involved is about 2" to 5" or more. The necessary voltage for the above purpose is obtainable with a neon sign transformer.

The heating current for the filament is best obtained by means of a 110-10-volt heavy current transformer. Both of the transformers mentioned require the use of suitable rheostats in the primary sides to vary the impressed voltages.

*Sources and costs of materials (costs when purchased, but subject to inflation)*:

Hyvac Pump. Central Scientific Co.. Chicago (price includes motor and base. Pump alone is $50.00 and requires 1/6 H.P. motor), $90.00.

110-5000 volt transformer, No. 721,161-2, Jefferson Electric Co., Chicago (a neon sign transformer is suitable), $6.50.

110-10 volt transformer with secondary current rating of 40 amperes (though lower ratings could be used, since it is all over in so short a time), $6.50.

Rheostat for primary of high volt. trans., Chicago Apparatus Co., 1735 N. Ashland Ave., Chicago (No. 67680-2, 0-1570 ohms, .3 amps.), $6.00.

Carbon rheostat for primary of 10-v. transformer, Chicago Apparatus Co. (No. 67700 carbon compression rheo.), $12.00.

10" x 10" x 1" glass base plate, Pittsburgh Plate Glass Co., Pittsburgh, Pa., (order with unfinished edges), $2.00.

Two pieces tungsten wire 3" long and .04" diameter, approx. (.03" to .06"), General Electric Co., Schenectady, N. Y., .50.

Brass stock: 2' of ¾"; 1' of ¼"; 4' of ½" and ½' of 1" brass rod (estimated), $1.50.

Piece rubber pressure tubing, Chicago Apparatus Co. (1 foot of No. 78880 D, 5/16" inside diameter, ¼" walls), 30 cents.

Bell jar, Chicago Apparatus Co. (No. 75640D 8½" inside diam., 15" high), $5.50.

Vacuum wax (vacuum sealing compound 94216), Central Scientific Co., 79 Amherst St., Cambridge A Station, Boston, Mass., per can, .70.

Total: $131.50.

Note: This list is only to suggest possible sources of the materials. Most amateur groups will be able to gather all the necessary equipment for a fraction of the amounts listed.

Next month, Prof. Yeagley will give the actual, step-by-step instructions for aluminizing.

HERE are the data on designing Barlow lenses, by Jack Haviland, author of the chapter on O. G. design, in ATMA.

"In designing a Barlow the formula on page 227, ATMA, becomes:

$$f_f = -F \times \frac{V_f - V_c}{V_f}$$

"Since the V figure for crown is larger than that for flint, the numerator of this fraction will be negative which, when multiplied by -F will give a positive result.

"Still keeping track of signs and substituting in the formula at the bottom of 226 we get

$$f_c = -F \times \frac{V_c - V_f}{V_c}$$

"$V_c - V_f$ is positive for reasons stated above, so that when this is multiplied by -F the result is negative.

"This is the reverse of what happens in designing a positive objective. The Barlow lens is also used 'backward,' with the flint facing the incident light. Of course it is probably possible to design the lens the other way with the flint negative and the crown positive. The Germans make telescope objectives with the flint leading and positive. Either would have to be reconsidered from the standpoint of spherical aberration, however. But, since we already have empirical data that give suitable corrections for spherical aberration, let's not go into that, just for the fun of turning a lens around.

"Regarding spherical aberration: for incident light, parallel or converging, a convex surface facing the light is best. For diverging light a concave surface is indicated. The general idea back of this is that the above prescriptions lead toward making the deviation a minimum; that is, the bending of the ray at incidence and emergence is more nearly the same at both surfaces.

"A Barlow designed as above will have a slightly convex surface on one side and a concave on the other. Since the flint is the one with the convex surface it is faced to the light to get the best correction for spherical aberration. This is the only reason the flint leads. It is also the reason why the crown leads in a telescope objective.

"Barlows add color, especially with short focus—*f*/8 or less—reflectors. With a long

*Figure 4:* R. W. Porter

focus reflector or refractor they are not needed to get power with reasonable (⅜" or longer) eyepieces. So what?"

Thinking moods of two veterans are shown in Figures 4 and 5. Philip E. Myers of San Diego caught Porter, while R. W. Munn of Pittsfield took the picture of Everest thinking how much work it will be to grind the 20" Pyrex disk before him.

IN a letter, J. D. Beardsley, of the Washington Instrument Co., present address

is the author of the notes on metal mirrors, ATMA, page 67, says:

"One little point about lead laps. Lead is rather gummy, as you know, and small abraded particles of it will roll up into small balls and lift the mirror off the tool. An ordinary 50-50 solder lap is much better

*Figure 5:* A. W. Everest

and it would seem that a 90-10 mixture would be better. This incidentally is the composition of Chase 'sweat' solder, a rather expensive item for a large lap, but a thin film can be attached to cast iron if it is first copper plated and then tinned.

"You can suggest to the boys to try chrome green ($Cr_2O_3$), which has been washed, for polishing metal mirrors. That is the stuff the commercial boys use for buffing; they say that rouge dirties stainless steel. I have used the stuff on crystal quartz and it cuts much faster than rouge. It costs more than rouge but if time is worth anything it is a money saver.

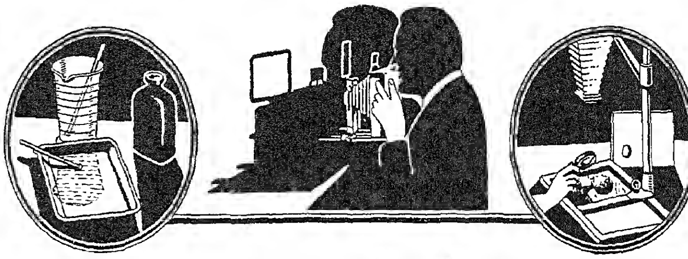
"Dr. Canfield tells me that substituting *nickel for copper in speculum metal* gives a very elegant substance free from the reddish tinge of the copper alloys."

OLD settlings from local eyeglass opticians' shops contain rouge that has already been worked down and, after proper washing, will not scratch. Often the owners are glad to be rid of it. This tip recently reached us from Dr. S. H. Sheib of Richmond, a contributor to ATMA, just before his unfortunate death from pneumonia, late in April. We should not have said, "will not scratch," but "should not scratch."

IN ATMA, Clark tells how to make an optician's spindle, and now a dealer's descriptive literature on a factory-built vertical spindle reaches us. Price, only $245! Most TN's will make Clark's kind, instead!

IT seems that we have erroneously "promoted" Dr. Gaviola, author of the chapter in ATMA beginning on page 76, to be director of the great observatory at La Plata, Argentina, giving him that title in the by-line at the head of that chapter. Modestly he now "resigns," saying there is a director already, and asks readers to cross off the word "Director" after his name.

TWELFTH annual powwow of amateurs will be held at *Stellafane*, Saturday,

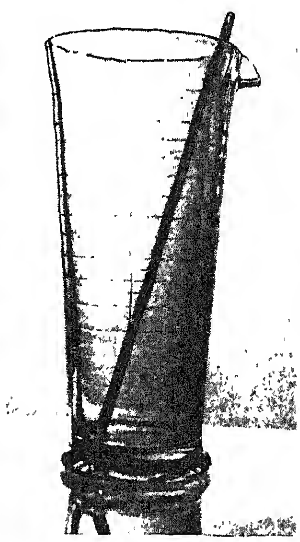


# CAMERA ANGLES

**Conducted by JACOB DESCHIN**

## Photographing Glass

PROBABLY the chief reason for the failure of many amateurs in their attempts to photograph glass subjects lies in improper lighting. Once the problem involved is thoroughly understood, this subject should offer no further difficulty. The problem is simply this: Glass, like water or a mirror, is a strong reflector of light. Throw a light upon it from the front and the picture is lost. To illustrate: we once had occasion to photograph a radio set with glass covered dials, and were obliged, unfortunately, to work with flash bulbs. Had regular lamps been used, we would have spotted trouble immediately, but as it was we simply blazed away with the flash bulb reflector attached to the camera, in the manner of the synchronized flash "gun." When the negative was developed, we found that one of the dials was completely obliterated. In place of the dial the negative showed a dense black ring which was represented in the print by blank white paper. The next time we were called upon to use flash bulbs in a similar case—not a radio set this time but a pretty lady looking through a glass case containing a pair of chemist's scales—we knew better and, removing the "gun" from the camera, slanted the reflector at an angle so that the light swept across the face of the glass at an angle instead of hitting it head on.



"Graduate"

This is one phase of glass photography. Here is another. As if to counteract its tendency to throw back glaring splotches of

haps unique advantage that because it is transparent it is often possible to light it for photographic purposes entirely by transmitted light, in the same manner as one views a transparency. For the best results, however, this light ordinarily should not be sent directly from the source but by way of a reflecting background. That is, the light should be trained on the background, which should, of course, be of a bright enough tone to reflect light through the glass subject being photographed. All three photographs illustrating this discussion were made in this manner. It is a method which ought to prove very successful in the photography of laboratory apparatus, glass vases, glass bottles, and similar subjects.

Although the general lighting scheme was based on the same basic maneuver of transmitted light, the procedure in each case was a little different. In "Still Life" the only light used was that reflected from the gray felt background. Of course, in the case of a glass bottle partly filled with a dark liquid, it may sometimes be found necessary to provide illumination from the front to get

"Brilliance"

shadow detail in the dark portion of the subject. When lighting from in front of the subject is required, the illuminant should be thoroughly diffused. A polarization filter will practically eliminate all glare and reflection. This filter is used in the regular filter mount and placed over the lens. In "Graduate" the subject was placed on a sheet of plain glass which was elevated a distance of about six inches from the table.

"Still Life"

background, as in "Still Life" and another light (a spotlight, to narrow the circumference of the beam) illuminated the blotter. Thus, reflected light was sent through the glass from two directions. In "Brilliance" the light was sent directly through the glasses, resulting in a series of shadow patterns and soft highlights.

## Negative Viewer

DESIGNED to facilitate the selection of miniature negatives or motion-picture frames to determine their suitability for enlargement, the recently introduced Bee Bee Film Negative Viewer is said to do the job to perfection. The instrument has a lens at one end of a tube and a groove at the far end for the insertion of the negative. The lens gives a magnification of four times, the focusing tube is of polished nickeled metal and the slides are of black enamel. While intended primarily for use with 35-mm negatives, additional grooved slides are available to take 16-mm and 8-mm motion-picture frames.

## "Draftsmanship"

A FEW characteristic tools of the trade, an angle view, and the light at a slant to throw long shadows, and we have a picture symbolic of the draftsman's work. Most trades and professions lend themselves to similar treatment. The accessories chosen for arranging the set-up should have significance, the lighting planned for a dramatic effect, and the general composition so disposed that the essence and spirit of the trade or profession symbolized is apparent.

## Filter Wallet

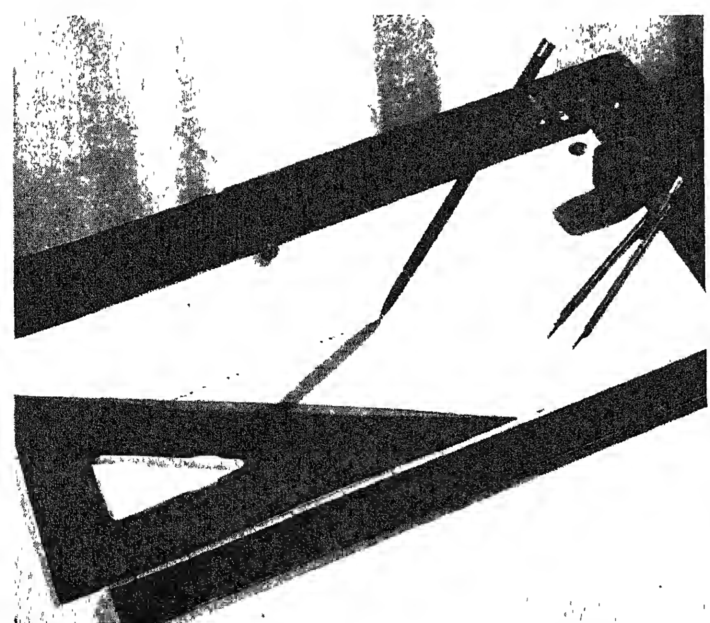
A FILTER wallet that accommodates as many as five filters and a holder, and when folded fits snugly into the vest pocket, is now available. The wallet is made of imitation leather and consists of four pockets, each one holding an unmounted glass filter in any of the various tints and in sizes 25, 31, and 39 mm. There is also a larger pocket which takes the holder. The whole outfit folds up quickly and safely and is held together with a snap.

## M. I. T. Goes Pictorial

PROVING that their interest in photography is not exclusively technical, the students and faculty members at the Massachusetts Institute of Technology recently held a photographic exhibition in which they displayed a preference in off-hours for the pictorial rather than the technical in photography. The show was held under the auspices of the Faculty Club and included work done, in the main, with miniature cameras, though users of simple box cameras also won recognition. The response to the exhibit, following two similar ones held last year, was so great that it has been decided to hold an annual spring competition, during which prizes will be awarded for outstanding prints in various classifications.

## Super Plenachrome

INCREASED speed in an orthochromatic film is offered by Agfa Ansco Corporation in its newest addition to a famous line of roll films made for amateur use—Super Plenachrome. In addition to greater speed, the makers say, the new orthochromatic film possesses higher color sensitivity, improved brilliance, and extreme latitude. The new

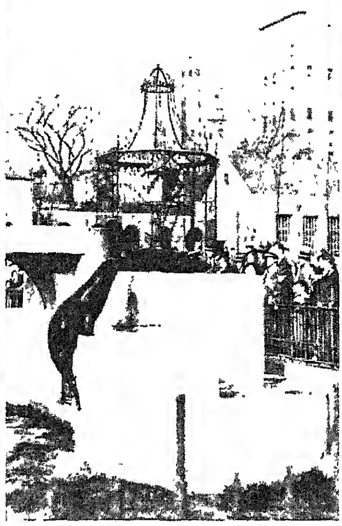


"Draftsmanship"

film is protected against unsharpness due to halation and is provided with a special surface coating to prevent scratches in handling.

## "Star Performer"

NOT all "performance" photographs are taken in the theater. The pet-shop window or the zoo also offer unusual opportunities in this field, with the added advantage



"Star Performer"

that the lighting is that of the sun, at least in many instances. When the picture "Star Performer" was taken, we were not the only ones blazing away. There were at least a dozen others in the vicinity all doing the same thing; most of them using miniature cameras, by the way. And no wonder, for the sea lion is a wonderful entertainer.

## Fellowship for Weston

PHOTOGRAPHY in recent years has spread its influence into so many fields that one might almost call it the universal occupation of mankind, whether vocationally or avocationally. A little while ago we learned, not altogether in surprise though with considerable pleasure, that Edward Weston, of the Pacific Coast, who is probably as famous for his sand dunes, halved cabbages, and other studies in sharp texture as Steichen is in his field, has been awarded a Guggenheim Fellowship to make a series of photographic studies of the West. There's something to look forward to. Whatever other qualities they will contain, we can be sure that they will be technically perfect, that a large view camera will be used, that all the pictures will be contact—as befits a member of the F:64 Club, that group of exponents of "pure photography"—and that everything in the picture will be sharp, clear, and clean-cut, both as to definition and contrast.

## Flexible Tripod

EXTREME versatility was the aim of the designer in perfecting a small tripod now available called the Flex-a-Pod. Besides its use in table-top photography, its special construction makes it useful also in making shots from the floor, in macrophotography,

ing, in the creation of animated cartoons, and in general photographic work. A tilting and panoramic device is also provided. The Flex-a-Pod may be lowered to a height of only 1½ inches or raised to 7½ inches by using one extension rod, or 12 inches with two. The tilting and panoramic attachment may be removed and fitted on one's regular tripod.

## Single Lens Stereo-photography

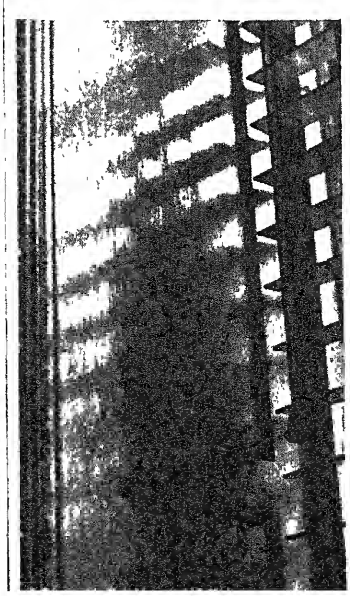
WE are all familiar with the trick of getting a stereo-photograph by shifting the camera for the second exposure about 2½ to 3 inches after making the first exposure, but ordinarily it is done either on a tripod or some other support, in which the distance is accurately measured. However, we recently learned of one man who uses no tripod at all, but a trained sense of the correct distance to shift while holding the camera in his hands. After making the first exposure, he extends the right leg to the right, and moves his head—while holding the camera (a Contax) to his eye—approximately the distance called for in stereo work.

## Champion Salon Exhibitor

DEVER TIMMONS, A.R.P.S., of Coshocton, Ohio, whose "Fevrier," a chlorobromide, you may have had the pleasure of seeing at one of the photographic exhibitions, is reputed to be the world's most active exhibitor. The authority for this is "Who's Who in Pictorial Photography," published annually in the "American Annual of Photography," and the fact on which it is based is that during the year ending July 1, 1936, Mr. Timmons had a total of 364 prints on exhibition in 67 American and foreign competitive salons. No, Mr. Timmons is not a professional photographer but an enthusiastic amateur whose livelihood comes not from pictures but from the manufacture of chemicals.

## "Afternoon Shadows"

THE glossy paint on the window casing and the ribbons of alternating light and shadow constitute the attractions that in-



duced the photographer of "Afternoon Shadows" to aim his lens. He used a reflex camera (which was ideal for the angle and the composition of the subject) and gave an exposure of one second at F:5.6 on medium speed panchromatic film.

## Hamlet's Ghost and the "Candid"

THE fame—or notoriety—of the American candid camera "fiend" has crossed the ocean to England with the recent departure from these shores of John Gielgud, who made a considerable impression in his rôle of Hamlet in a New York City theater. In talking to his countrymen about New York recently, he told his London listeners that while he thought New York "a grand place to work" there was "one new habit" which he loathed.

"The latest fashion," he said, "is to take a miniature camera to the theater and spend all your time taking snapshots of the performance. It got on my nerves. There were never fewer than four of these camera fiends in stalls.

"All the time I was trying to create the atmosphere of ghost scenes at the beginning of the play I would keep hearing the click, click, click of cameras."

A sad state of affairs, indeed, but we are sure that by this time Mr. Gielgud must have discovered the "habit" of theater snapshooting is as prevalent in England as it is in America and that, moreover, where the "candid" camera is concerned the whole world is kin.

## Double Exposure

WE admit it. It was a mistake. But what's the difference? Don't you think it's good, just the same? Here's the alibi: We were trying out a new 35-mm miniature camera with a semi-automatic film-changing device and forgot to change the film. We had made a shot while walking in the park and the next time we used the camera it was to photograph a ballet dancer. "Mirage" was the result.

## Enlarging Exposure Meter

CONVENIENCE and accuracy in determining proper exposure on different contrasts of enlarging papers for negatives of varying densities is assured by a new exposure meter for this purpose called the Lios Grandoscope. Pipe-shaped in appearance, the device is furnished with an eyepiece at the end of a focusing tube which slides into a longer tube, the latter fitting into the "pipe" shaped end which contains the translucent glass screen by which the exposure is read. The field of the Grandoscope contains a series of numbers and the last visible number seen is the key to the required exposure.

## Prices Coming Down

REPORTS from two reliable sources, relayed to this department, indicate that as the result of negotiations in Germany by American importers of cameras and accessories, some favorable concessions in connection with the exchange value of the German mark have been made, thus enabling importers to bring the prices of imported cameras considerably lower. The reduction is said to be as high as 15 percent in some cases. We may, therefore, look to a general downward revision of camera prices all along the line. This will be welcome news to many who have felt that the prices of some of the higher-priced outfits ran too high, and should furnish an additional stimulus to the already thoroughly stimulated activity of supplying camera hobbyists with tools to work with.

## Legislating Miniature Cameras

THE way of the candid picture hunter is hard. When he was few in number, and timid to boot, nobody gave him much thought. He could shoot in theaters, in restaurants, in the subways, and he could do it in such a way that no one was the wiser. But now he is great in number, he is everywhere, and he fools no one any

longer. Also, he sometimes turns out pictures that are much too candid to suit the subjects themselves. So his wings are being considerably clipped on all sides. Two such clippings are reported by *Leica Photography*, one being a campaign by movie stars and prominent people in Hollywood to bar miniature cameras from the resorts and amusement places they frequent because of the often unflattering results of the pictures produced and published, and the other a move in the State of Missouri to enact a statute requiring the licensing of miniature cameras.

While disapproving of these moves as being practically "a ban on the freedom of speech," *Leica Photography* adds, however, that "the resentment of famous movie stars or other prominent people is justified in some cases, for publication of certain candid pictures would be injurious to them."

"Our friends," the magazine continues, "will even take offense at our actions if we continually thrust cameras unexpectedly into their faces and later 'proudly' present them with pictures which, to phrase it mildly, are unflattering. On many occasions it may be wise for candid photographers to use discretion in displaying or publishing some of their candid pictures."

## PICTURE MARKET

IF you are interested in making some money with your camera, a new market has recently opened that will consider your products if you will take the trouble to offer them. It is The Salon Photographique, 1619 Broadway, New York City, and Miss Gladys Hutchins is the one to write to. Miss Hutchins announces she has started this Salon to act "as the authorized representative of photographers in every classification of still photography" and that her "compensation will be on a commission basis."

## PAPER-WRINKLING DISTORTIONS

A NEW method of creating caricature effects under the enlarger was recently described in *The New York World-Telegram* by Mario Scacheri, staff photographer. After discussing the more familiar method of tilting the easel vertically and horizontally, Mr. Scacheri describes paper-wrinkling or buckling:

"Find an old print that you do not value," he writes, "and work with the plain white, reverse side. Tack the upper corners to a board. Then turn on the light in the enlarger and push some bulges into the paper. Experiment until these bulges come where they do the most good. They can be straight across, or slanting, but they should lengthen the nose, give a pinhead effect to the cranium, or paint the lily in some other interesting way. The higher the bulge the greater the distortion, and also the greater difficulty in printing.

"When you have the right effect, substitute a sheet of bromide paper for the blank. Turn on the red light of the enlarger, buckle up the paper as desired, and hold the bulges in place with thumb tacks along the edges. You have already got your focus, at full opening, while monkeying with the blank paper. Close the lens down to F:11, and give twice as much time as you would if you had closed it to F:8."

## THE SCIENTIFIC AMERICAN DIGEST

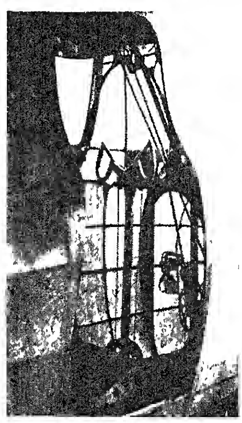
(*Continued from page* 41)

solution is kept in wooden tubs used for the treatment and is too dilute to harm or discolor the crate or baskets containing the cherries.

The legal requirements are that the maximum amount of arsenic on fruit shall be less than 0.010 grains of arsenic trioxide per pound of fruit, not more than 0.018 grains of lead per pound, and less than 0.010 grains of fluorine per pound. Cherries ordinarily fall below these limits but the washing process suggested above brings them well within legal requirements without injury.—*D. H. K.*

### True Human Flight

THE Italian Government has offered a prize of 5000 dollars to the man who first succeeds in making a flight with the unaided power of his muscles over a two-kilometer closed course and who reaches an altitude of 15 feet during the flight. The Germans have also offered a prize, written some excellent rules, published some scientific memoirs, and made accurate preliminary tests of a purely laboratory character. An American citizen, Enea Bossi, a member of the Budd Manufacturing Company, has gone ahead in more direct fashion and built a glider, propelled by two chain driven airscrews. With this man-powered glider a flight of ⅝ of a mile has been achieved in Milan, Italy.



***Above:*** **Interior of the foot-propelled aircraft, showing pedals and controls.** ***Below:*** **A view of the glider on one of its trial flights held in Milan, Italy**

Mr. Bossi holds the second pilot's license issued in Italy, and has had vast experience in the construction of aircraft of various types, particularly those using stainless steel. Accordingly, while he regards this latest venture purely as a hobby, he has developed this novel machine in the most approved engineering style.

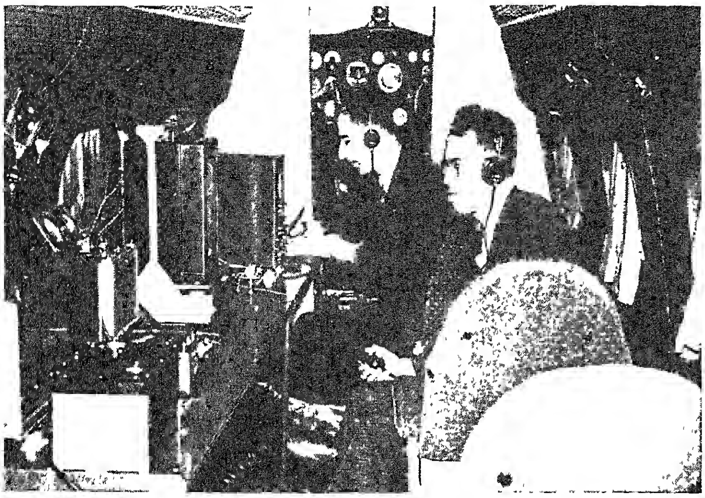
First he towed a light primary glider behind a bicycle, and made seven consecutive tests for a distance of about 1400 feet each. Some help was given to the cyclist and to the glider at the start; the glider took off and flew several times for distances of between 150 and 300 feet. This gave Mr. Bossi the assurance that with a better streamlined glider, with a little more wing area, flight could have been continuously maintained.

His next test consisted of removing the chain from a bicycle and equipping it with a propeller 6½ feet in diameter, rotated by means of gear and chains through the usual pedaling system. With this propeller Mr. Bossi obtained the truly remarkable speed (on the ground, of course) of 25½ miles an hour, for a distance of one kilometer.

In a third test, Mr. Bossi was towed on a bicycle behind an automobile, with a spring scale in the rubber cord towing line. This indicated that at 21.8 miles an hour, a pull of 16 pounds and a horsepower of .92 were necessary.

This preliminary scientific work taught Mr. Bossi a great deal. He deduced that the average man could deliver enough power to the airscrew to pull a glider through the air at about 20 miles an hour and that the gyroscopic effect of the large propeller was very troublesome, so that two airscrews rotating in opposite directions should be used. In general he established sufficient data for his final design. The propeller was designed with particular care, with the blade systematically varied from hub to tip. The maximum pull of the airscrew at rest was 19.8 pounds—during a continuous man-effort of 10 minutes the pull was 13.2 pounds. It was found that the most efficient pedaling speed was 60 revolutions per minute, allowing the screws to turn up 170 r.p.m.

The interior of the streamlined cabin of the glider, with the pedaling and chain and gear arrangements, is shown in one of our photographs. Another photograph in-



dicates the general appearance of the bicycle glider in flight.

Mr. Bossi has kindly given us the following main dimensions of his design: Wing spread, 51 feet; length, 20.2 feet; height, 6.6 feet; total wing surface, 215 square feet; airfoil, N.A.C.A. 0012; propeller diameter. 6.4 feet; number of propellers. 2; number of revolutions in flight at maximum short effort, 200; number of revolutions at normal effort in flight, 170; weight empty. 198 pounds; weight of pilot, 172 pounds; total weight. 370 pounds.

It is rather hard to gain speed from a dead start before the airscrews have bitten into the air, so to speak, and in all probability a landing wheel will be provided in the future to be connected at will with the pedaling system. Another possible development is to allow the airscrew under favorable conditions to wind up a shock cord, thus storing energy for subsequent use.

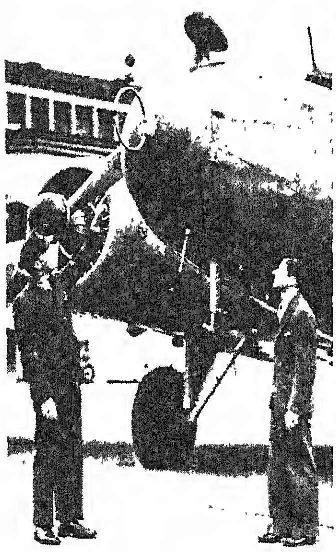
At present, of course, the craft is only a scientific curiosity. But we must remember one thing. A skilled glider pilot can, using thermal currents, stay up almost indefinitely and fly cross-country for a distance of, say, 150 miles. Imagine such a pilot being able to keep going with his pedals when the thermal currents or other up-gusts give out temporarily. Obviously he will then be able to keep going much more readily and also determine his direction much better than when he has to rely on his skill and favorable air currents alone.

What an absolutely fascinating sport is just in the offing!—*A. K.*

## Radio Laboratories in Flight

THE great airlines are making constant experiments with aircraft radio, and are converting their ships into veritable laboratories. Thus in one of our photographs two radio technicians of United Air Lines are shown at work in a passenger cabin in which upholstered chairs have been replaced by a test stand with delicate recording devices. The flying laboratory is equipped with a number of special measuring instruments to record electrical charges of clouds through which the plane will fly on test flights. A new type of de-icing equipment will eliminate possible ice static. Four special anti-static antennas have been developed by United and will be subjected to rigorous investigation. They include the tear-drop shaped device mounted on top of

*Above:* Equipment in the flying radio laboratory. *Below:* Two of the four types of experimental aerials



the fuselage (as shown in another photograph); the ring type projecting from the nose of the fuselage; a rotatable ring under the belly of the ship; and a fourth type installed inside the fuselage. The thin shafts projecting downward from the nose and from the side are "lightning rods," designed to discharge static collected by the metal skin of the transport. Nothing is so important from a safety point of view as these experiments in aircraft radio.—*A. K.*

## A Wealth of Aviation Literature

NO member of the public who seeks accurate but interesting information on modern aviation need complain to-day. It is a pleasure to see the authentic, fascinating, beautifully illustrated books that have recently come off the press. We have three books particularly in mind, each excellent in its kind.

"Once to Every Pilot," by Captain Frank Hawks, is written by a famous aviator, who has himself experienced many adventures, knows flying from every possible angle, and is a "pal" of everyone of note in the brilliant and friendly band of adven-

turous pilots. In Captain Hawks' entrancing book we meet them all, and at the most hazardous instants of their lives. Eddie Allen, the test pilot, "lands on a cloud" and brings a new ship to earth after the most trying maneuvers. Jimmie Mattern, flying 'round the world, is lost flying the Atlantic, gobbled up in Siberia—apparently—and it is many weeks before the world finds him. Casey Jones relates how he almost lost Gene Tunney when flying to the famous Dempsey-Tunney fight. Rickenbacker, Jimmy Doolittle, George Vaughn, and many others . . . we meet them all within the covers of one beautiful volume. It is all very well to say that flying should now be a matter of cold efficiency; these stories still thrill us.

"Your Wings," by Assen Jordanoff, combines perfect illustrations by Frank Carlson, and tabloid simplicity with real accuracy in imparting the elements of flying, the art of aerobatics, the fundamental principles of navigation, the elements of meteorology, and so on. Here is an absolutely painless yet reliable method of grasping the fundamentals of flying.

Last but not least is "The Wonder Book of the Air," by C. B. Allen, Aviation Editor of *The New York Herald Tribune*, and Lauren D. Lyman of *The New York Times*. These men have seen everything, known everybody in aviation. They have produced an admirable popular semi-historical, semi-informative book on aviation. Early History, Flights Round the World, Why an Airplane Flies, In the Pilot's Cabin, Flying Phraseology, and Sky Slang, are the names of representative chapters. A splendid treat for any boy keen on aviation from the age of 12 to 72.—*A. K.*

**FOOD**

**LIGHT lunches served on commercial airplanes might seem to be a small item. However, the food bill of 11 commercial airlines that serve meals on planes was close to half a million dollars in 1936.**

## American and British Aircraft Annuals

AS it so happened, we received on the same day the Aircraft Year Book for 1937 of the Aeronautical Chamber of Commerce of America, and the Air Annual of the British Empire for 1937. For any one who wishes to obtain a comprehensive view of the marvelous strides being made by aviation, nothing better than either of these two publications can be found. Even the man professionally interested in aircraft development and constantly following technical publications in this field will find much to instruct and even to amaze him. For the layman they may be as thrilling as a best seller.

An adequate review of these books is almost impossible with the space at our disposal. The British Annual will probably have more reward for one seeking novelty, since the advances of less familiar foreign practice are recorded. Thus in the United States the Goodrich Overshoes, which move out under pressure and force ice from the wings, have become so familiar that we can scarcely conceive of any other device that would do the job. But the British have quite another method. Their plan is to force ethylene glycol slowly through leather strips extending along the leading edges of the wings. This depresses the freezing point of the super-cooled moisture striking the surface and prevents solidification.

Another point of difference lies in the policies adopted in the procurement of new designs. In the United States, constructors who wish to obtain contracts for military aircraft must build prototypes entirely at their own risk and expense, and take their chances in a competition. Under stress of the re-armament program, the British Air Ministry now has adopted the policy of ordering aircraft "off the drawing board." In the past the policy has been to go through the sequence of mock-up, experimental prototype, a development contract, and finally the production contract, a process which took anything up to four years. "Off the drawing board," the development of a new service type may take only a little over a year. Not only would the adoption of a similar policy in the United States be infinitely fairer to constructors, but it would help us to keep ahead of foreign developments in fighting planes. Such a happy result might more than compensate for the possible waste in ordering a ship or two that might prove to be failures.

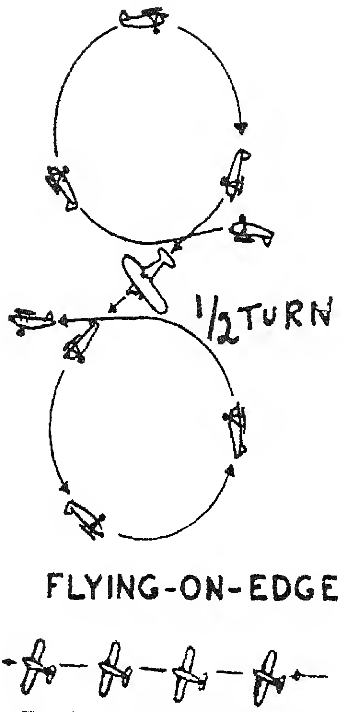
There is another tendency in Air Ministry work which we might well reflect upon. Our policy is to check everything, particularly stress calculations, in the various bureaus—Navy Bureau of Aeronautics, Matériel Division of the Army Air Corps, Air Commerce Bureau of the Department of Commerce. The aircraft designer and constructor is, of course, a child in knowledge and skill compared with the officials! The British are adopting a far more reasonable attitude. While the Air Ministry still reserves the right to check the strength and safety of aircraft, the manufacturer assumes a far greater burden of responsibility. This is precisely as it should be. The less an industry is kept in swaddling clothes, the more rapid will be its progress. We do not remember that government bureaus helped the American automobile to its present wonderful stage of development!—*A. K.*

## Aerobatic Competition

TO revive and intensify public interest in air racing, the St. Louis Air Race Association recently held, among other events, an "Aerobatic Competition" under the sanction of the National Aeronautic Association. Such contests have often been held in Europe, but are new to the United States. The rules of the competition take a little understanding. There was an elimination and a final contest, each of ten minutes' duration.

For each maneuver there was allotted a coefficient of difficulty, from 1 to 10; and a proficiency rating from 0 to 5. Thus an outside loop had a coefficient of difficulty of 4, and if the judges gave a perfect rating, the contestant would have scored 20. The judges' ratings were averaged for each stunt executed. The judges included such authorities as Jimmy Doolittle and Al Williams, and since the stunts were executed at less than 1500 feet above the ground, there was no difficulty in scoring.

We did not know that there were 84 different stunts in existence, but there are. A spin is so easy that it only has a coefficient




Two daring aerobatic maneuvers described in the accompanying note

of difficulty of 1. A loop is such child's play that it only rates a coefficient of difficulty of 1. The same low or slightly higher ratings apply to a variety of stunts which once upon a time were considered marvels of the flying art. What then do these airmen now consider difficult? The double loop shown in the sketch *does* rate 10. The pilot enters into an outside loop in an inverted position, performs an outside loop, then rolls his machine over and makes another outside loop lower down, and finally comes out in horizontal flight. If asked to perform this maneuver, we would give it a coefficient of difficulty not of 10, but of ten thousand! "Flying on edge" rates just 4; another name for this is "vertically banked flying." There were also Immelman turns, flick half rolls, inverted spins; vertical 8's of inverted position, and so on.

What is the effect on the public of such stunting done comparatively near the ground? They get a thrill while the performance lasts. Afterwards their feeling of safety in the air is apparently increased. Inquiring Reporter Swanee Taylor, at one of the air races, investigated this very point. A colored man told him: "Why, after seeing them stunts, a trolley car would be no safer to me than an airplane."—*A. K.*

## No More Landing Gears?

We have had occasion to report in these columns the "belly" landings made by Beechcraft planes, with retracted landing gear. [February, 1937, page 108. *Ed.*] Such landings were either a matter of sheer necessity or in the nature of a stunt. Now rumors reach us, from well informed sources, that somewhere in the Middle West, "belly" landings, on ships without any landing gear, are being made successfully, time and time again. The fuselages of the airplanes used in these experiments are themselves provided with shock-absorbing elements on their undersides. On the field where the experiments are being carried on, a movable track is shifted around by a powerful tractor. The movable track is designed somewhat on the principle of the escalator, and planes are shot off the track as if catapulted. On alighting, they move against the motion of the track and are brought to rest in a very short distance.

If these experiments demonstrate full practicability, we may see the landing gear disappear completely. After all, the engineers go to great pains to design retractable gears, with additional complexity and weight, and these gears are used for only a small fraction of the flying time. What a step forward it would be in performance or at least in greater payload if they could be dispensed with completely.—*A. K.*

## Elastic Umbrella

A NEW umbrella with a replaceable cover offers new convenience to travelers and shoppers. A telescopic frame in which both the ribs and the handle telescope is covered by an elastic cover made from latex. This cover is highly elastic and can be attached to the frame readily by hooks fastened to a fabric tape around its edge. The tape not only serves as a means for attaching the cover to the frame, but at the same time holds the opened ribs in position. The umbrella folds into small compass and, by an ingenious arrangement of telescoping the ribs, opens to full size with no more effort on the part of the user than that required to open an ordinary fabric umbrella. —*D. H. K.*

## Not Necessary to Stop Reading to Rest Eyes

READ when, where, and how you like, but insist on sufficient illumination, use glasses if glasses are necessary, and have a periodic eye examination every two or three years. This is the fundamental principle for the care of the eyes, declares Dr. Theodore L. Terry, instructor in ophthalmology at the Harvard Medical School.

Do not try to save your vision by avoiding reading, sewing, or the movies, he advised, because eyes do not wear out. It is disease, he declared, that destroys vision.—*Science Service.*

## Comfort for Alligators

HUNDREDS of miles of electric soil-heating cable have been buried in the ground for such ordinary agricultural purposes as supplying heat for hot beds, cold frames, propagating benches, germinators, and other horticultural applications. Now, in the Brookfield Zoo at Chicago, 600 feet of the cable is being used to warm the feet of alligators and turtles.

Zoo Director Edward Bean noticed that the reptiles were sluggish during the cold weather, even though the thermometers indicated comfortable room temperatures. The 'gators and turtles moved so slowly they hardly seemed alive; they did not care to eat; they avoided the sand in the reptile house. Director Bean found that the sand was too cold for comfort, so far as the reptiles were concerned. He then installed 600 feet of General Electric soil-heating cable, and thereupon the inhabitants of the reptile house resumed normal activities.

The flexible lead-sheathed cable has had

numerous unexpected applications. Aquaria and lily ponds containing delicate tropical fish or rare plants that cannot withstand chilled water have been protected with lengths of the cable. Floors in buildings are being kept warm and dry with it. Other installations of such cable are supplying low heat to liquid products in pipe lines. Industrial applications have included immersion heating for miscellaneous storage, treating, and manufacturing processes in such varied places as glass, chemical, and soap factories. Poultry brooders are being kept warm with the cable, thermostatically controlled; downspouts and gutters of homes and other buildings are kept from being ice-clogged.

## Titanium Makes Paper Opaque

Because its index of refraction is much higher than that of the vehicle of printing ink, titanium oxide added in small amounts to paper makes even thin papers opaque and prevents printed matter from showing through from the other side. In this respect titanium pigments are superior to others used in sizing and finishing paper stock. The opacity of a 16-pound rag-content paper is increased from 74 percent to 86 percent by the addition of 3.8 percent titanium oxide. This difference is especially important in making papers for modern books of 1000 pages or more to be bound in a single volume, since without this added opacity reading is extremely difficult.—*D. H. K.*

## Testing Machine Defeats Coiners

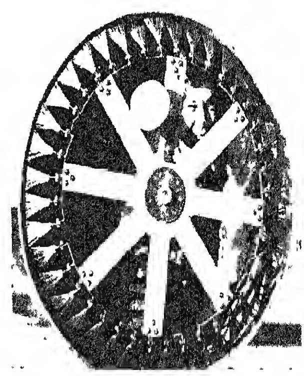
Counterfeiters' Enemy No. 1, the invention of a Sydney, Australia, engineer, R. J. Lyttle, is now at work for the first time. It has been installed at the Commonwealth Bank, where it is handling 1000 coins every 3½ minutes, counting them, bagging them, and decisively and unfailingly rejecting "duds."

Lyttle has received inquiries from banks all over the world about his machine which electrically analyses every coin it handles and compares it with a master coin. So accurately does it work that it even rejects shillings which were made in China some time ago and circulated in Australia and which had the unusual fault of containing 4 percent too much silver.—*Australian Press Bureau.*

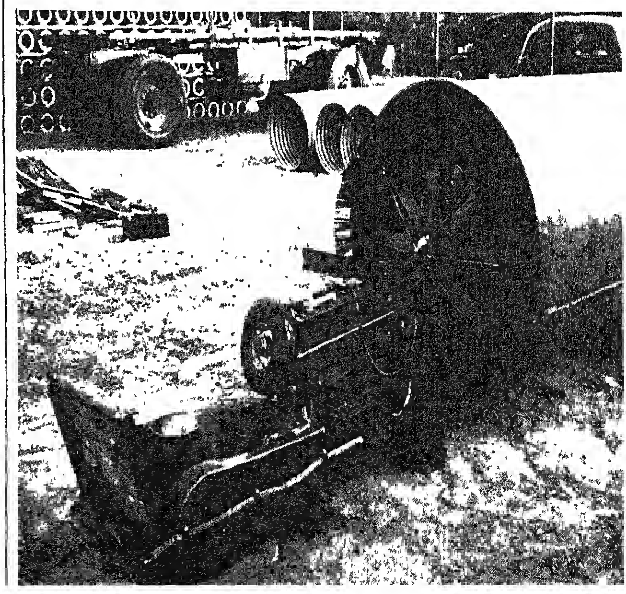
## Motor Car Inside a Water Main

A new water pipe 15½ miles long recently built by the Los Angeles Bureau of Water Works & Supply was an incentive to devise a better means of inspecting the interior of water mains. This particular main is 36 inches in diameter which would offer no serious problem as a limiting dimension in the design of a motor-propelled vehicle suitable for carrying an inspector and equipment. Requirements were made more difficult, however, by valves 20 inches in diameter and the necessity for taking the vehicle into or out of the pipe through 11- by 18-inch elliptical manholes. In addition to conveying inspectors through the line, a major function of the equipment is to test the enamel with which the inside of the pipe is coated and to treat the "holidays" or small defects in this coating such as are found by the usual high-voltage brush test.

These several requirements have been met by a vehicle which is used even on grades up to 8 or 10 percent, sometimes pulling two trailers with a total of three men. The conveyance has traveled 20 miles per hour on level ground and once the writer attained



*Above:* The inspection motor car inside a 36-inch water main. *Below:* The car ready for an inspection trip



a speed of 15 miles per hour while backing inside the pipe line. It can be used for inspection and for conveying materials used in patching or placing enamel.

Essentially the motor car is composed of three parts: a battery box, a right- and a left-wheel unit. The battery box serves as a chassis to which the other units are attached. Two 150-ampere-hour, six-volt storage batteries are used, connected in series, and mounted one above the other. Braking is accomplished by means of a fiber shoe which may be pressed against the tire of the right wheel by a hand lever. On the left wheel unit a starter-generator, such as is used with automobile engines, is coupled to the single driving wheel by chain and sprocket. The motor can be reversed by shifting the brush ring. The starter button is operated by the right foot and a spring clip on the end of a flexible lead permits the motor to be operated at voltages ranging from six to 12 in two-volt stages.

Potential for the brushes is supplied by an induction coil (from a model T Ford) mounted on the side of the battery box. The brushes subject the enamel to a potential of about 10,000 volts. As the carriage moves forward at two or three miles per hour, the entire periphery of the pipe continuously is swept by this high potential. The enamel, with its normal thickness of 0.010 inch, withstands this voltage if there are no flaws. The slightest opening, however, causes a visible and audible spark as the brush passes. When exactly located, the spot is covered with enamel by the man in the trailer. —Howard Wait in *Engineering News-Record*.

## Fertilizing Fish Ponds

By adding fertilizer to fish ponds to promote the growth of vegetation upon which the fish feed, the Czechoslovakian government has been able to increase the yield of fish. Approximately a ton of mixed fertilizer and lime is used per ton of fish produced. Both chemical fertilizers and barnyard manures are finding markets for this purpose.—*D. H. K.*

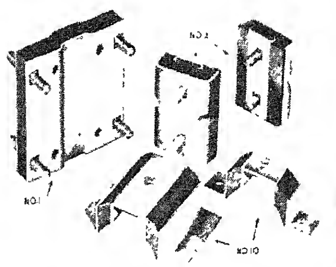
## Mechanical Monsters Tamed By Rubber

Taming of machinery that frazzles the nerves of employees and threatens to crack the buildings in which it is located, is the latest victory of engineers, whose perfection of rubber suspensions for heavy factory units is opening an era of freedom from vibration and noise.

According to J. D. Tew, president of The B. F. Goodrich Company, whose engineers developed vibro-insulators—shown on this page—as a means of easing nervous strain and fatigue of employees working in buildings containing heavy machines in the Goodrich plant, rubber mountings are now being adapted to solve similar problems in nearly every industrial establishment.

"Fatigue studies showed a great reduction in nervous strain on employees tending the units after vibro-insulators were installed on seven machines weighing a total of 238 tons," declared Mr. Tew. "The range of this latest improvement will soon be extended when four machines weighing a total of 100 tons are equipped with rubber mountings.

"After their development of rubber com-



Standard types of rubber mountings designed to be used to reduce the destructive vibration of heavy machinery

positions for mountings for automobile engines and small motors to banish vibration," Mr. Tew said, "our engineers decided to try suspending in rubber one of the heavy factory machines. An 80-ton rubber masticator in the company's Akron plant was mounted in rubber and transmitted vibration was virtually eliminated, ending the threat that the pounding of the machine would open a crack in the building in which it was located."

## Artificial Radioactive Material

The possibility of applying artificial radioactive elements to biologic research and radiation therapy has aroused much interest. Some investigators have prophesied that artificial radioactive elements may eventually replace radium and radon for certain types of therapy.

M. and Mme. Joliot, son-in-law and daughter of the late famous Mme. Curie, were awarded the Nobel Prize (1934) for their discovery of artificial radioactivity. They bombarded boron with alpha rays, making a substance called radio-nitrogen, which gave off radiation resembling the radiation from radium. The life of the product, which is about 14 minutes, is insignificant compared with the life of radium. Other investigators in many parts of the world have followed this line of research. For the bombarding medium some have used the neutron, the electrically uncharged elementary particle possessing nearly the same mass as the hydrogen atom, and others have used the deuteron, the charged atom of heavy hydrogen. To date, more than 40 elements have been made artificially radioactive, and the half-life of this radioactivity varies from a few seconds to about 14 days

In the radiation laboratory in the Department of Physics, University of California, a device called the cyclotron has been invented, which creates exceedingly high velocities of deuterons. The high velocity of these deuterons is generated between the poles of a huge electro-magnet. Essentially, its operation consists of deuterons being continuously accelerated 'round and 'round in a spiral. This gives them their high speed energy, which otherwise would be unobtainable. The deuterons reach a wall of one electrode and pass out of it through a slit; then they pass through a thin vacuum-tight metal window. Materials such as common salt are placed at this point. It is possible to bombard the sodium in the salt and make a product known as radio-sodium. The half-life of radio-sodium is 15½ hours. The chief advantages of these products would seem to lie in the homogeneity of their

radiations, the suitability of their half-lives for therapeutic uses, and the non-toxicity of their decay products. Several other research laboratories have acquired cyclotrons, and more are obtaining them now.

The life of the radioactive substance is short and therefore would probably not be as detrimental to the human being as radium when it is taken internally. More experimental work is required. At present it will be retarded because of the unavailability of machines to produce artificial radioactive materials. Other instruments have been developed for this purpose, but the cyclotron seems to present the greatest possibilities. Its bulk of several tons and its great expense necessarily restrict research activity except in localities where the cyclotron is already available.—*Journal of the American Medical Association.*

## Warning On Use of Nose Drops by Laymen

THE mother who puts drops in her child's nose or sprays it to relieve a cold may inadvertently give him pneumonia or other serious lung trouble. So may the lay person who uses a certain type of nose spray or drops for his own cold.

This danger was pointed out by Dr. Paul R. Cannon of the University of Chicago before the Federation of American Societies for Experimental Biology. He and Dr. Theodore Walsh found in animal studies that the oil of these sprays and drops may get into the lungs, frequently causing edema, or watery swelling, and pneumonia.

The particular kind of nose sprays which Dr. Cannon warned against are those in which the medicinal substances are dissolved in light oils. Mineral oils are used in many of the preparations because they keep better than plant oils. Plant oils, however, are safer because if they do get into the lungs the tissues can dispose of them. If these sprays and drops are used expertly, as by a physician, there is probably little danger. It is their indiscriminate use by the untrained person that may cause serious trouble.—*Science Service.*

## Portable Vibrograph

OUR highly mechanized age has raised the serious problem of what to do about vibration. Faster traffic speeds, the design and construction of new machinery and vehicles, building and mining operations, and many other activities make the study of vibration important to safety, comfort and economy.

Among a number of models of vibrographs manufactured by the Cambridge Instrument Company for recording the characteristics of vibration, the instrument illustrated is particularly interesting because of its portability and its novel method of writing its records in permanent form on a strip of celluloid. This portable vibrograph is designed for making spot tests of high-period vibrations and can be applied to a vibrating surface in any plane.

A small projection at the base of the instrument is pressed against the surface at the point where it is desired to measure the vibration. The vibration is transmitted through a series of levers to a fine stylus moving over a strip of celluloid film wrapped around a drum, the levers giving a mechanical magnification seven to one. A celluloid strip 35 millimeters wide and 16 centimeters long is moved past the stylus by means of a clockwork mechanism, the speed of which can be varied from 3 to 20 millimeters per second by means of a switch. The stylus actually deforms the celluloid plastically and does not *scratch* it.

Means are provided to raise the stylus out of contact with the film to protect its point when the instrument is not in use. An independent time record is traced on the inner surface of the strip by a second stylus enclosed within the drum, and controlled from a separate contact-breaking clock arranged to make and break the electric circuit at regular intervals of 1/10th of a second. Four-way connecting leads pass through the removable handle to connect the apparatus to a battery. A push-button switch on the handle starts and stops the clockwork driving the film and the time-marking mechanism.

The records obtained with the instrument are of micro size, and are projected and enlarged for examination and photographic reproduction. The record line is very clearly defined and will bear considerable magnification. Records can be removed from the instrument and examined immediately after they are made without chemical treatment or any lighting precautions, and are not destroyed by water, oil, or dirt.

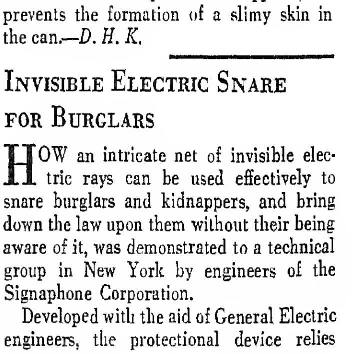
## Non-Skinning Paints

THE tendency of paints to form skins on the exposed surface is counteracted by a new synthetic addition-compound recently put on the market. This material has no adverse effect on the paint when applied, but prevents the formation of a slimy skin in the can.—*D. H. K.*

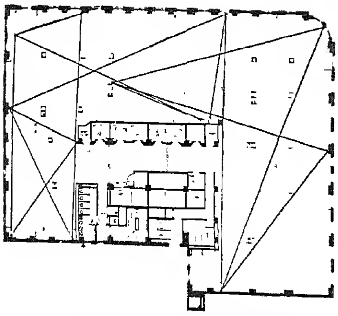
## Invisible Electric Snare for Burglars

HOW an intricate net of invisible electric rays can be used effectively to snare burglars and kidnappers, and bring down the law upon them without their being aware of it, was demonstrated to a technical group in New York by engineers of the Signaphone Corporation.

Developed with the aid of General Electric engineers, the protectional device relies



*Above:* The portable vibrograph, and, *below,* a record of vibration made by a stylus on moving celluloid



Invisible reflected light beams protect these offices from burglary. See complete explanation in text below

principally on the photo-tube to foil marauders. The protective network was made up of the beam from a standard automobile headlight bulb, from which all visible rays of the light spectrum had been filtered. By a multiple system of mirrors, this single invisible beam was reflected back and forth across a room, around corners, and at different levels and angles until the guarded area was completely protected against movement of a body in any direction.

The system is extremely flexible in that the energy released by interfering with any beam can be used for various purposes, such as sounding an outside bell or siren. The type of installation demonstrated was unique and presaged more modern and effective methods. It automatically cleared a telephone line, dialed police headquarters, and transmitted a spoken message summoning aid. After this message had been repeated for a minute and a half, the device "hung up" and then called the telephone company, repeating its message for the same period as a check upon the first call. Having done this, it once more cleared the line and automatically placed the telephone back in service.

It could just as easily have dialed the fire department, or summoned aid from other quarters. The invisible beams are sensitive to smoke as well as human intrusion. A small button is provided to check the apparatus so that operation can be assured before leaving the protected premises or retiring.

## Proof of the Matter is in the Making

THE following note from *Science and Culture* (Calcutta) describes an experiment which is to be made by the noted Dutch-German physicist, Professor Paul Debye, most recent Nobel Chemistry Prize Winner. If this experiment succeeds it will provide a tangible answer to many who have refused to believe in the possibility of "heavy matter."

"Probably the reader knows that astronomers have discovered a system of bodies in the heavens which are known as white dwarfs, in which the density of matter may be 60,000 times, nay, even a million times, that of platinum which is the heaviest metal known on the earth. How does this thing take place? Matter must be existing inside these stars in a form which is not known to us on the earth. It is well known that the atom which we know on the earth consists of the nucleus with a positive charge surrounded by a shell of electrons. On subjecting matter to compression, the diminution of volume which takes place is opposed by the mutual repulsion of the electron shells and atomic nuclei. Further increase of pressure will then lead to the successive stripping of the electron shells, until in the end we have nothing but the stripped nuclei occupying an extremely small volume with free electrons lurking between them in an unknown form. This pressure ionization is supposed to exist in white dwarfs.

"This kind of effect is rendered probable by the existence of neutrons, the new elementary particle discovered by Chadwick in 1932. This neutron is of extremely small dimension and it has been found to be a constituent of all nuclei. Further, the neutrons and protons appear to have strong attraction for each other when very close. In white dwarfs, therefore, most of the matter probably consists of agglomeration of neutrons and protons.

"Debye proposes to produce this state by a novel experiment. He will make a cyclotron, an apparatus which has been invented by Lawrence of California and is found to give us a very copious supply of neutrons. These neutrons will be shot into a path which is maintained at absolute zero of temperature. Debye thinks that neutrons will then cling to each other and will form a sort of compact mass which, volume for volume, will be a million times heavier than ordinary matter and will thus be a piece of white-dwarf matter."

**FIERY RIVER**

**"STARDUST" on the river Seine during the Paris 1937 International Exposition which started in May, will transform the water into a river of fire. A metallic dust is scattered over a thick layer of oil on the water, while shafts of vari-colored lights are focused upon this glittering surface from a tower on the river bank. So far, we have been unable to learn just how the fishes are faring with this deadly diet.**

## Billion Elms Threatened by Disease

WITH the nation's elm trees counted for the first time, the American Forestry Association recently announced that unless immediate steps are taken by Congress to control the spread of the Dutch elm disease, destruction of a billion trees, with a monetary value of more than 750,000,000 dollars, is imminent. The saving of this tree resource, the extent and magnitude of which was heretofore unknown, the association stated, constitutes one of the most urgent conservation problems of the federal government and the nation.

## Paraffined Fruit

COATINGS of paraffin wax are being applied to fruits and vegetables to preserve them from the garden to the kitchen. By properly selecting the grade of paraffin used, a coating can be applied to tropical fruits and to vegetables, including even the lowly turnip, which preserves their freshness over long periods of time. The paraffin is removed with the peel.—*D. H. K.*

# CURRENT BULLETIN BRIEFS

*(Bulletins listed as being obtainable through Scientific American can be supplied only by mail)*

HOUSE PLANTS, by Robert Van Tress, (Botany Leaflet 20) is a 36-page booklet that describes and illustrates nearly 30 different plants that can be raised successfully in pots and window boxes in the home. The author gives complete instructions as to the proper care and feeding of plants and concludes with a list of numerous plants, other than those illustrated, which may be grown in the home. *Field Museum of Natural History, Chicago, Illinois.—37 cents.*

HOW AN AMERICAN TECHNICAL LABORATORY SOLVES THE PROBLEM OF FAST DYES is a 12-page mimeographed booklet that shows how it is now possible to buy materials which will retain their color as long as the fabric holds together. The development of the dye industry in the United States has reached a point where the fastness of dyes and the technique of their application are such that there is no longer any excuse for the value of a fabric being reduced or ruined because of improper dyeing. *Write for Bulletin 737A to Scientific American, 24 West 40th Street, New York City.—3 cent stamp.*

DESCRIPTIONS OF AIRPORTS AND LANDING FIELDS IN THE UNITED STATES, AIRWAY BULLETIN NO. 2, lists in concise form all such fields, giving such pertinent data as exact location, surface, runways available if any, how the field is marked, and what facilities are available to the flyer. Since this bulletin is available only in a limited quantity, it can be sent only to those who actually have need for it. *Department of Commerce, Bureau of Air Commerce, Washington, D. C.—Gratis.*

BROWN PYROMETER covers a complete line of millivoltmeter pyrometers — indicating, recording, and controlling. It also describes a new moisture-proof rotary switch, multiple key type switch, control relays, valve mechanisms, thermo-couples, and accessories. It is of particular interest to plant managers and executives. *Write for Bulletin 737B to Scientific American, 24 West 40th Street, New York City.—3 cent stamp.*

CONSOLIDATED ODOR ABSORBERS IN AIR CONDITIONING shows how one organization has attacked a problem peculiar to the developing science of air conditioning. Recirculated air in such systems is apt to become objectionable unless some method of odor absorption is used. The present booklet shows several types of such absorbing units and tells specifically of their applications. *Write for Bulletin 737C to Scientific American, 24 West 40th Street, New York City.—3 cent stamp.*

AIR TRANSPORT IN FOREIGN COMMERCE, by Colonel Edgar S. Gorrell, is a reprint of an address delivered before the National Foreign Trade Convention, and is a definite plea for more business for the airlines. It shows specifically the advantages that will accrue to the American business man who has control of any appreciable volume of foreign trade, if he makes use of the commercial air service that is now available to practically all parts of the world. *National Foreign Trade Council, 26 Beaver Street, New York City.—Gratis.*

FACT IS SOUNDER THAN FICTION is a small pamphlet which draws attention to the desirability of fact finding by actual laboratory work rather than by letting the consumer of manufactured goods find out for himself the desirable and undesirable features. This booklet is chiefly intended for those who have a genuine interest in research and testing. *Electrical Testing Laboratories, 80th Street and East End Avenue, New York City.—Gratis.*

HOW AND WHEN TO SPRAY AND DUST FRUIT TREES, VEGETABLES, PLANTS, ORNAMENTALS is a pamphlet that covers the subject in tabular form, telling what sprays and dust are most desirable and when they should be applied. The information will be of interest and value to owners of small gardens as well as to managers of the largest farms and orchards. *E. I. du Pont de Nemours & Company, Inc., Wilmington, Delaware.—Gratis.*

ALTERNATING CURRENTS IN RADIO RECEIVERS, by John F. Rider, is predicated upon the idea that a more detailed and elaborate presentation of certain basic A.C. phenomena is desirable, particularly as applied to modern radio receivers. This bound book of 94 pages will be of particular value to the radio technician. *John F. Rider, Publisher, 1440 Broadway, New York City.—60 cents.*

GLORIFY YOUR PRODUCT is a 20-page booklet that shows how aggressive business firms are definitely increasing their sales through the medium of talking motion pictures. The booklet tells of some of the organizations that have made use of this advertising method and of the results which they have obtained. *Gratis to advertising and sales executives. Herman A. DeVry, Inc., 1111 Center Street, Chicago, Illinois.*

THE WILD TURKEY ON THE MISSOURI OZARK RANGE, by Harold L. Blakely, is a comprehensive report covering the life history, features limiting abundance, field management, and future conservation problems of this particular game bird. 32 pages including a bibliography. *United States Department of Agriculture, Bureau of Biological Survey, Washington, D. C.—Gratis.*

WHO SELECTS AMERICA'S MOVIES? is a discussion of the advantages and disadvantages of "block booking," a phase of motion picture distribution that has been subjected to vigorous argument pro and con for a good many years. *Motion Picture Producers and Distributors of America, Inc., 28 West 44 Street, New York City.—Gratis.*

CHEMICALS is a listing of acids and heavy chemicals, agricultural chemicals, electroplating chemicals, electroplating equipment, and zinc and alloys, arranged in alphabetical form and giving data of particular interest to purchasers. *E. I. du Pont de Nemours & Co., Inc., Grasselli Chemicals Department, Wilmington, Delaware.—Gratis.*

# LEGAL HIGH-LIGHTS

## Patent, Trademark, and Related Legal Proceedings That May Have a Direct Effect on Your Business

By ORSON D. MUNN, Litt.B., LL.B., Sc.D.
New York Bar
Editor, Scientific American

### Processed Product

THE sale of the product of a patented process does not infringe a patent for the process. The United States patent statute provides that any person "who has invented or discovered any new and useful art, machine, manufacture or composition of matter" may obtain a patent therefor. The word "art" as used in the patent statute has been interpreted as synonymous with "process" or "method" and means an act or a series of acts performed upon a given subject matter to transform or reduce it to a different state.

The question frequently arises whether the owner of a process patent can bring suit for patent infringement against one who sells a product which was made by a process infringing the process patent. It is well established, however, that the mere sale of the product of a patented process does not infringe the patent for the process. This question was recently passed upon by the Circuit Court of Appeals for the Second Circuit in a suit for infringement of a process patent. In that case the evidence showed that the defendant employed the alleged infringing process prior to the granting of the patent and that subsequent to the granting of the patent he did not employ the process but merely sold the products which had been made by the process prior to the granting of the patent. The court stated: "A mere sale of the product of the process does not constitute an infringement of a process patent."

There has been considerable agitation by inventors from time to time to amend the patent law so as to permit the owner of a process patent to proceed directly against the seller of the product of the process. It is contended by those favoring such an amendment that the owner of a process patent has no effective remedy unless he can proceed against the seller of the product. As yet such attempts to amend the law have not met with success and the only remedy open to the owner of a process patent is a suit against the user of the process.

### Full of Holes

"GENUINE imported Swiss cheese" means cheese made in Switzerland and no other place—at least in New York State.

In a recent case in the New York Supreme Court the defendant offered for sale as "genuine imported extra fine quality Swiss cheese" a cheese which was manufactured in Denmark. The cheese was of the type known as Swiss cheese and it was imported from Europe into the United States. Nevertheless, the court found that the words "genuine imported Swiss cheese" had acquired a special meaning indicating cheese made in Switzerland, and granted an injunction against advertising cheese from other countries in this manner. In reaching this conclusion the court stated:

"Over a long period of time the words 'genuine imported Swiss cheese' have acquired a secondary meaning in the sense that they are associated in the minds of the public, with a special type and quality of cheese imported from Switzerland. While the defendants, in offering for sale 'genuine imported extra fine quality Swiss cheese' express a literal truth, they nevertheless convey to the public the impression that the cheese offered is imported from Switzerland."

### Patentable Substitute

ORDINARILY the substitution of one material for another in a machine or article of manufacture does not amount to invention and can not be protected by patent.

The Court of Customs and Patent Appeals passed upon this question in a recent case involving an application for a patent on a high-speed rotary cutter made of steel of the high-carbon and high-chrome type. There was nothing new in the design of the cutter and the high-carbon high-chrome steel was also old. The inventor contended that the invention resided in making the cutter out of the particular material selected. The Patent Office tribunals refused to grant a patent and the Court of Customs and Patent Appeals sustained the Patent Office, stating: "As a general proposition of law, the mere substitution of materials is unpatentable." In reaching this conclusion the court found that high-carbon high-chrome steel had been used in other tools and that its properties were well known. The court found further that the inventor had merely selected the material for its well known properties and in so doing had merely exercised "the mechanical skill of one experienced in the art" rather than the skill of an inventor.

While the general proposition that the mere substitution of materials is unpatentable appears to be clear and understandable, its application to particular cases is sometimes confusing. Thus, in cases where a new and unexpected result is obtained by substituting one material for another, a patent will be granted. Also, where an inventor, by selecting a particular material, solves a problem of long standing in the art, which other inventors had tried unsuccessfully to solve, he is entitled to a patent which will protect the use of the particular material selected.

The difficulty of this problem is illustrated by a recent case decided by the Court of Appeals for the District of Columbia, in which the Commissioner of Patents was ordered by the Court to grant a patent covering a heating coil, for cracking hydrocarbon oils, made of an iron-chromium-nickel alloy. In that case the Court found that prior to the use of iron-chromium-nickel alloy for making the heating coils as taught by the inventor, the cracking coils were the source of considerable trouble due to their rapid deterioration and corrosion. It had been thought that the difficulty was occasioned by the acids in the hydro-carbon oils and unsuccessful attempts had been made to solve the problem by making the coils of acid-resisting material.

In the present case the inventor found that the corrosion was caused by sulphides in the hydro-carbon oils and he selected a material which resisted the corrosive action of the sulphides. By so doing, the Court found he solved a problem of long standing in the art and held that he was entitled to a patent.

It will be appreciated from the foregoing examples that while it may be stated, as a general proposition of law, that the substitution of materials is not patentable, there are many cases in which the selection of a particular material may amount to invention and be entitled to patent protection.

### Honorable Discharge

FOR some time after the World War the Army and Navy disposed of large quantities of merchandise which were purchased and resold to the public by stores which included in their names the words "Army and Navy" in one form or another. In recent years the quantity of goods sold by the Army and Navy in this manner has greatly decreased, and many of the stores including the words "Army and Navy" in their names handle substantially no merchandise from the Army and Navy.

The Federal Trade Commission recently proceeded against such a store charging that the words "Army and Navy" in its name were misleading and that their use was injurious to its competitors and to the public. The Commission found that at one time approximately 90 percent of the merchandise offered for sale by the store was procured from the Army and Navy but that in recent years as little as 10 percent was procured from this source. The Commission then ordered the store to cease and desist from using in its name the words "Army and Navy" or either of them.

The order of the Commission was subsequently reviewed by the United States Court of Appeals for the District of Columbia when the Federal Trade Commission applied to that court for enforcement of its order, and the court sustained the order of the Commission, stating:

"The first of the two issues of law in the case is whether the conclusion of the Commission that the use of the words 'Army and Navy' in the Trading Company's name is an unfair method of competition, is justified. It is. The Supreme Court has ruled that false and misleading representations as to the origin of a commodity constitutes an unfair method of competition."

# Books SELECTED BY THE EDITORS

## CAREERS AFTER FORTY

*By Walter B. Pitkin*

TO mention that this is by the author of "Life Begins at Forty" is sufficient recommendation. In this book, Professor Pitkin has added inspiration to what before might have been defined as "wishful thinking." He shows how the economic setup has made such changes that many new opportunities in entirely new fields have opened for the person of more advanced age. This is as it should be. The problem of finding employment for those approaching and in middle age having been recognized as a very definite problem, it naturally follows that a solution must be found if national progress is to continue. Professor Pitkin's stimulating observations are worthwhile reading for every man and woman faced with this problem.—$1.90 postpaid.—*F. D. M.*

## TEXTBOOK OF GEOLOGY

Part I, Physical Geology. *by Chester R. Longwell, Adolph Knopf, and Richard F. Flint, Professors of Geology at Yale.*

Part II, Historical Geology, *by Charles Schuchert and Carl O. Dunbar, Professors of Paleontology at Yale.*

THESE two volumes constitute a complete textbook of geology, one which occupies a "central" position as the standard detailed treatise, text and reference book of our present period. Unlike astronomy, in which textbooks become out of date in a year or two, geology is more fixed, and a substantial work such as this should be good for at least 10 or 20 years as a book to read and add to one's library as an authority and reference book. These volumes are so written that the outside person can start without prerequisites and expect to understand the whole content with little or no difficulty. The language is clear, straightforward.

Part I deals with fundamental geological phenomena: first comes a general view of the earth, then follow chapters on the breaking down of rocks, the effects of water, geology of lakes, glaciers, wind erosion, marine erosion and deposition, sedimentary rocks, volcanoes, crust deformation, earthquakes, metamorphism, earth's interior, origin of mountains, minerals, rocks, topographic maps. Total, 514 pages with 341 illustrations.

Part II, consisting of 551 pages and 332 excellent illustrations, covers in detail the whole drama of the history of the earth from its origin two billion years ago clear through to neolithic man. It gives a chapter to each of the geologic periods, its rock formations and changes, and its record of evolving life, and extra chapters to the principles of interpreting fossils, evolution, length of geologic time, and the geologic history of man.

The two volumes are purchasable separately, though Part II takes for granted the general working knowledge in Part I, without which the reader would often be perplexed, but Part I, alone, would cause no trouble.

Part I: $3.95 postpaid. Part II, $4.20 postpaid.—*A. G. I.*

## THE MAGIC SHOW BOOK

*By Alexander, the Magician*

COINS and pencils, pieces of paper and handkerchiefs, matches, string, and drinking glasses can be made to do strange things in the hands of one who has studied this small book. In it, a noted magician has swept away the mystery around so many of the smaller tricks done with common objects and has explained them clearly and concisely for laymen. Of the more than 100 tricks included you may already know a few (this book is indicated for children from the ages of 10 to 14), but there are many new ones, both simple and difficult to perform.—$1.65 postpaid.—*F. D. M.*

## TERMITE CITY

*By A. E. Emerson, Prof. Zoology, University Chicago, and Eleanor Fish.*

A JUVENILE but adult-readable description of the lives of termites, with emphasis on natural history. It says that termites eat members of their community who won't work, and this keeps their communities vigorous. That is a difference between termites and Americans today: here the won't-workers eat us.—$1.65 postpaid.—*A. G. I.*

## THE DRAMA OF CHEMISTRY

*By Sidney J. French*

THOSE who were exposed to courses in chemistry in high school and college frequently find, only a few years later, that the background is so dim as to be almost non-existent; attempts to brush up their knowledge with the conventional textbook, frequently take them far beyond their depth. It is for just such people that the present book was written. It supplies the reader with the essential highlights of knowledge in compact and understandable form, thus making it possible to bring into more clear focus the aforementioned hazy background. A minimum of formulas is given—only those that are absolutely essential to clarification of the text. Particular attention is paid to the relationship between modern chemistry and everyday life.—$1.15 postpaid.—*A. P. P.*

## THE WORLD OF SCIENCE

*By F. Sherwood Taylor, Ph.D.*

SURELY the author has embodied a whole "world of science" in this big book. In fact, since the famous "Outline of Science" was published, some years ago, no book so pregnant with facts is recalled. In 1045 text pages the whole realm of pure science, applied science, engineering, and industry seems to be thoroughly covered and covered accurately, everything being clearly described and explained. If this reviewer were to be transported to some desert isle and allowed but one book this would almost have to be that book, by the very logic of its great and wide content. A remarkable synthesis; the author deserves congratulation.—$4.00 postpaid. —*A. G. I.*

## PROCEDURES AND METAPHYSICS

*By Edward W. Strong*

A STUDY of the philosophy and mathematical-physical science in the 16th and 17th Centuries, for students of the history of science.—$2.65 postpaid.—*A. G. I.*

## VOCATIONAL GUIDANCE THROUGHOUT THE WORLD

*By Franklin J. Keller and Morris S. Viteles*

HIGH-SCHOOL students often write to the editors of this journal asking for advice as to what branch of engineering or science might be best for them to enter, not realizing that many things must be taken into consideration in answering such a question and that the answer itself would have to be of book length to be even partially satisfactory. These two authors have given, in something over 500 pages, about the best answer to such questions that could be put together for people generally, leaving

out the specific instances. Their work discusses, however, not exactly what is the best field to enter but how an education in any field might be obtained in the larger countries of the world. The young student would find this book difficult, so that it is best for the teacher to study and apply the psychological methods given therein for vocational guidance and analysis of the individual.—$4.20 postpaid.—*F. D. M.*

### TOURING WITH TENT AND TRAILER

*By Kimball and Decker*

MOTOR camping, whether it be roughing it with an ordinary camp outfit or living in luxury in a modern trailer, requires a technique of its own if the vacationist is to get the most enjoyment and comfort from his travels. Thus we have the reason for the present book, based on practical experience, that will enable the reader to skip many of the rough spots and avoid the trials and tribulations that await the uninitiated. It details such things as what equipment to take and what to leave home, how and where to camp, what kind of equipment is most suitable, and so on. Thoroughly illustrated with photographs which alone will make the reader yearn for the open road.—$2.65 postpaid.—*A. P. P.*

### TEXTBOOK ON SPHERICAL ASTRONOMY

*By W. M. Smart, Astronomer in Cambridge University*

THE second edition of a work published in 1931: errors have been corrected and three appendices added. The chapters are on spherical trig, celestial sphere, refraction, meridian circle, planetary motions, time, planetary phenomena and heliographic co-ordinates, aberration, parallax, precession and nutation, proper motions, astronomical photography (plate reduction), position at sea, binary orbits, occultations and eclipses. Appendices (new): method of dependences, stellar magnitudes, the coelostat. This book is all muscle (mathematics) and not fat (mere words).—$5.75 postpaid.—*A. G. I.*

### ELEMENTS OF ELECTRICITY

*By William Esty, Robert Andrews Millikan, Wynne L. McDougal, and other collaborators*

BY securing the services of more than a dozen authorities in their separate fields, the publishers of this book have been able to present a comprehensive review of the field of electricity, its fundamental laws and their practical applications in the business and industrial world. The result is a perfectly simply book that carries straight forward from a discussion of electricity and magnetism through elementary circuits. Ohm's law, light and power circuits, signal systems, induced currents, transformer construction, and electrical equipment. The text is prepared particularly for the beginner, contains very little mathematics, yet gives the fundamentals of the subject in a form that is easily understandable.—$2.15 postpaid. —*A. P. P.*

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### A MARRIAGE MANUAL

*By Hannah M. Stone, M. D., Medical Director, Birth Control, Clinical Research Bureau, and Abraham Stone, M. D., Associate Attending Urologist at the Sydenham Hospital, New York.*

A PRACTICAL guide to sex and marriage. Of such books, there have been many. Why, then, another? Because we find that many medical authorities especially recommend this book as outstanding. The ground covered is: fitness for marriage, biology of marriage, mechanism of reproduction, prevention of conception, problems of reproduction, art of marriage, sexual disharmonies, and health in marriage. The method of exposition throughout is by question-and-answer, and the questions are those which have been most often asked the authors by their consultants.—$2.65 postpaid.—*A. G. I.*

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### THE FORD V8 CARS AND TRUCKS

*By Victor W. Pagé*

"PRACTICAL" is the best word we can think of to describe this entirely new book which, in a manner of speaking, tears the Ford V8 apart and shows you every tiny detail of it, how it may be adjusted and repaired. In addition to information on the car itself, there are chapters on trouble shooting with laboratory test sets and on Ford V8 radio troubles. A history of the Ford Motor Company is included in the back section.—$2.65 postpaid.—*F. D. M.*

### REDISCOVERING ILLINOIS

*By Fay-Cooper Cole, chairman, and Thorne Deuel, Associate, Department of Anthropology, University of Chicago*

AN account of the excavations at a site in central Illinois, to some extent representative of sites in the Mississippi Valley. Detailed and technical rather than purely descriptive. A book for the professional and the enthusiastic amateur.—$2.15 postpaid.—*A. G. I.*

### BRASSEY'S NAVAL ANNUAL 1937

*Edited by Rear-Admiral H. G. Thursfield*

AS usual, this volume, now in its 48th year of publication, covers in splendid detail the navies of the world. Its editor has written several of the special articles in it, and others are by well-known naval authorities. As usual, it is extremely well-illustrated, gives the latest information on new types, outlines programs for the future, discusses naval air service, and has quite a large section devoted to profiles of British and foreign warships.—$12.50 postpaid.—*F. D. M.*

### SKY STORMING YANKEE

*By Clara Studer*

A BICYCLE shop forms the background of the story told in this book—the story of Glenn Curtiss. This noted aviator operated a bicycle repair shop at Hammondsport, New York, but because of his dream of speed and flight over the world, succeeded in gaining an Aero Club of America Pilot License No. 1. This license was a direct result of his flight which won for him the first leg of the Scientific American Trophy. He won the second leg the following year; won the Gordon Bennett Cup at Rheims, France; won the *New York World* prize of 10,000 dollars for a flight from Albany to New York; and lived to design a flying boat which is essentially the flying boat of today. In this brief review it would be impossible, of course, to go into his life in detail, but the complete story is in "Sky Storming Yankee," woven with a fine and sympathetic human touch. Curtiss stood for years in the foremost of the ranks of aviators in the world.—$3.20 postpaid.—*F. D. M.*

### THE STRUGGLE FOR THE PACIFIC

*By Gregory Bienstock*

WHETHER we like it or not, much of the future of the United States will be determined by some sort of solution of the problem of the Pacific. That problem is a very definite one, hinging upon our own possessions in that area and the existence of possessions of other world powers. In the future we will be concerned particularly with Japan's Pacific policy. There are, and will continue to be for years, rivalries in the Pacific, and any newspaper reader knows that the Philippines, shortly to become independent, will be the center of the hottest fight. Mr. Bienstock has discussed this set-up, giving the background, the present state of affairs as they concern all nations now represented in the Pacific, and adds long lists of bibliographies to which reference may be made for further data. It is one of the clearest presentations of this question that it has been our good fortune to see.—$4.20 postpaid. —*F. D. M.*

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NINETY-THIRD YEAR — ORSON D. MUNN, Editor


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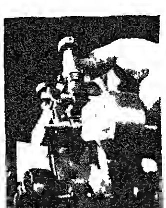

AFTER the now famous Jonker diamond, described on page 94 of this issue, had been cleaved following months of study of the cleavage planes, it was set up as shown in the photograph reproduced on our front cover. Then followed additional months of sawing, using a phosphor-bronze disk operating at 5000 revolutions per minute. The disk was supplied with olive oil and diamond dust. Sometimes the whirling disk made no progress into the stone for days at a time, but nothing else could be done. Only time, patience, and constant effort could achieve the desired results.—*Photograph courtesy Copper and Brass Research Association*




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# 50 YEARS AGO IN . . .

# SCIENTIFIC AMERICAN

*(Condensed From Issues of August, 1887)*

PANAMA CANAL—"Recent advices from Panama show that serious injury to important portions of the excavations has been occasioned by the sliding down of the embankments, due to heavy rains. In some places the great ditch has been measurably refilled, and at some points it will have to be dug out a second time at great cost."

ECHIDNA—"Our engraving shows the rare and extraordinary echidna that has quite recently been discovered in Northern New Guinea (*Proechidna bruijni*). This curious animal in outward appearance resembles the hedgehogs in its spine-covered body and the ant eaters in its long and tapering snout. The latter is incapable of being opened, and the mouth consists of a small hole at the apex, through which the long and vermiform tongue is protruded. The spines are short and stout, but of needle-like sharpness, and spring from a thick coat of dark brown fur. The forefoot is furnished with three broad and nail-shaped claws, while those of

the hinder limb are long, sickle-like, and very sharp. Worked by the powerful muscles with which the creature is provided, these are admirably adapted for digging. The tail is rudimentary."

VINEYARD PROTECTION—"An exchange says that artificial clouds were recently created for the protection of vines from frost at Pagny, on the Franco-German frontier. Liquid tar was ignited in tin boxes and pieces of solid tar on the ground near the vines. Large clouds of smoke arose and protected the vines for two hours. Although vines in the neighborhood were injured by the frost, all that remained under the clouds were left uninjured."

MINICAM—"The process of instantaneous photographing is rapidly becoming an evil. We hear talk already about specialists in photography for instantaneous pictures since the 'Detective Camera,' as it is called, was put upon the market. The box is so small that it can be carried anywhere without the slightest inconvenience. . . . No operator is required to fit the camera and lens correctly in position for the party to be photographed. All that is requisite is to pull a string and the photograph is at once taken."

NAVAL STRENGTH—"It appears from the 'Universal Register' for 1887 . . . that Great Britain has 6 guns capable of penetrating 36 inches of unbacked iron, and 16 others which can penetrate 28 inches of the same material. Italy has 20 guns which can penetrate 33 inches of iron. France 14 guns which can pierce 27 inches, and 14 others able to penetrate 25 inches of unbacked iron. Russia has 20 guns and Spain 2 equal to the penetration of 24 inches of iron."

AMYL VARNISH—"This compound ether has recently come into use for manufacturing purposes without attracting any scientific attention. Its value depends on the excellent solvent power for pyroxylin which it possesses. Good soluble gun cotton will dissolve in it. . . . On this account it has become valuable to the manufacturer of celluloid and to the manufacturer of certain kinds of lacquer for coating brass and copper."

OIL-BURNER—"The Russian Minister of Marine has ordered liquid fuel furnaces to be fitted to the ironclad *Tchesme*, now under course of completion at Sebastopol. The decision is one of a very important character, since although liquid fuel has been applied to vessels of fairly large dimensions, this is the first time the use of it has been attempted on ironclads."

LIGHTING—"Perhaps most remarkable is that the coming of electrical lighting has not seriously hurt the business of the gas companies. Indeed, in many, very many, cases it has helped the gas companies, because, since its arrival the public have got used to having more light, and those using gas have turned on more burners to make up for the unwonted illumination about them."

FREIGHT HORSES—"English railroads do the major portion of their own carting, collecting and delivering freight at the freighters' doors. One of the largest companies, the Midland, have in constant employment no fewer than 3,200 horses; and of these 1,000 are located in London."

PNEUMATIC GUN CARRIAGE—"The pneumatic gun carriage at Sandy Hook, which we illustrate, is constructed after the famous Powlett design. It is worked by compressed air, which comes from a pipe connected with the breast of the carriage. By means of simple levers, this air, besides being used to check the force of the gun in recoiling after firing, can be made to train the gun, elevate and depress it, and move it quickly from side to side. The old style carronade and broadside gun, pygmies in comparison, could not be handled by their numerous crews more readily than the great modern gun weighing many tons can be worked by means of this really simple apparatus."

ALTITUDE—"The aeronauts Mallet and Jovis made an ascent, August 13, in the balloon *Horla*, starting from the Lavillette gas works, Paris. Their object was to penetrate to the greatest height at which it is possible to live. After a few hours' voyage in the air the balloon descended, landing in the village of Marche, Belgium. They reached an altitude of a little over four miles."

ELECTRICAL HEAT—"The Société des Usines Électriques of Berlin have announced that, in future, in addition to light, they will be prepared to furnish a supply of electricity for heating purposes. . . . For boiling water they have contrived a vessel having two cases, between which is placed a resistance coil. It is stated that with this appliance about 1½ pints of water can be raised to boiling point with 4 amperes 100 volts. In certain theaters electric stoves are employed for heating the curling tongs, the use of gas jets and spirit lamps being rigorously forbidden."

AND NOW FOR THE FUTURE

¶Radio waves tailored to measure for more efficient broadcasting, by Alexander Maxwell

¶Preventive medicine; what it means to the average man, by Prof. G. H. Estabrooks

¶Aircraft carriers; their place in modern navies, by Walton L. Robinson

¶All-American Canal; construction and economic value, by R. G. Skerrett

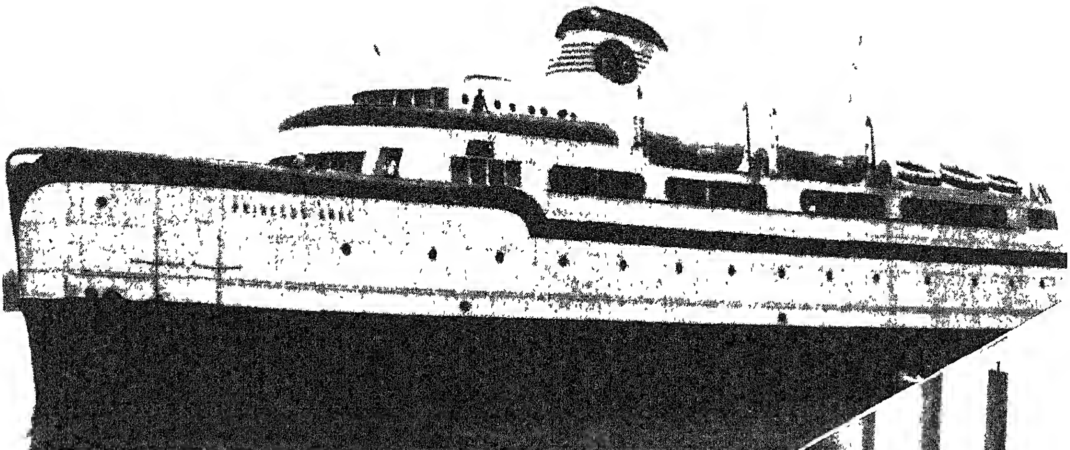
¶Air conditioning; health aspects of an infant industry, by Brewster S. Beach

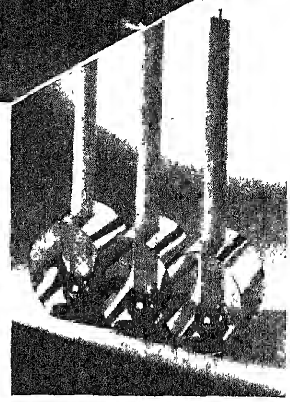

"MIGHTY GOOD SERVICE WE'RE GETTING THESE DAYS"
BELL SYSTEM SERVICE IS BASED ON Western Electric QUALITY
The name "Western Electric" on telephone equipment means high quality at low cost. Your Bell telephone company, and every other Bell company, shares the benefits of its centralized manufacturing.
This has brought constant improvement in the speed, clarity and efficiency of the telephone—saved millions of dollars for Bell telephone users—and helped to give this country the best telephone service in the world.
ORGANIZED FOR SERVICE TO THE PUBLIC
The Western Electric Company is an integral part of the Bell System. Its purpose is to provide a dependable supply of telephone equipment of high quality at low cost. The Western Electric plan of centralized manufacturing and distributing has half a century of proved benefits behind it. The increasing use of the telephone and the need for continued progress make it more important to the public than ever before.
BELL TELEPHONE SYSTEM
AMERICAN TELEPHONE & TELEGRAPH CO. AND ASSOCIATED COMPANIES
BELL SYSTEM

Photo Jean de Sieczki

## THE BIG TELESCOPE DISK—PRELIMINARY HAND WORK

In building the 200-inch reflecting telescope which is to be erected about 1940 in southern California, the mirror disk of Pyrex glass was made first and shipped by rail from Corning, New York, to Pasadena, California. The mounting is being made at Philadelphia by Westinghouse and shipped by water, while the observatory building is under construction at the site, Mount Palomar, 93 miles southeast of Pasadena. The first job was to grind the back of the disk flat on a machine, but before this could be done the edges of the ribs on the back were chamfered off by hand, as shown. Other data on page 77.





From ferry boats to candlesticks, modern design finds application to products which must have both efficiency and an attractiveness that will aid in making the product popular

**Industrial Design Promotes Profits . . . Not Mere Decoration . . . Built-in Appearance of Competency with Charm . . . Expresses Machine Age . . . Quality Now Comes with Quantity . . . Competition is the Driving Force**

# DESIGN FOR SALES

By PHILIP H. SMITH

WHEN sales of a manufactured product increase anywhere from 25 to 400 percent within a year, one of the factors most likely to have played a major rôle in the achievement is design. It doesn't matter whether the article is a sewing machine, a refrigerator, or a skillet, an expertly designed product attracts customers, swells sales volume, and garners profits.

Striking examples of industrial design success are to be seen everywhere: a mechanical refrigerator moved from fifteenth to third place in national sales volume in two years, largely because of design appeal.

A line of kitchen utensils proved so successful, even though launched during the lull of a summer, that the output planned for six months was completely sold out on the initial offering.

A check-writing machine jumped 66 percent in sales in one year, following a thorough-going re-designing.

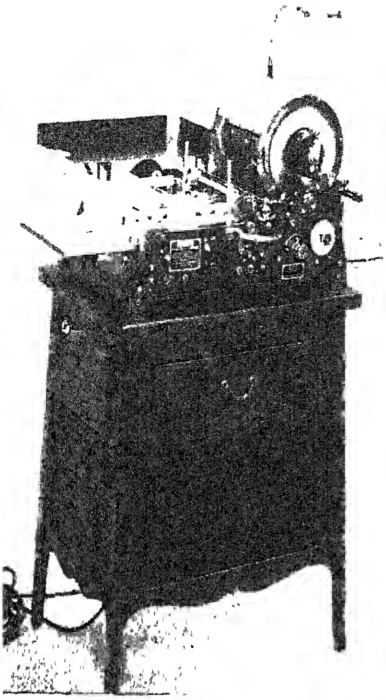
Even so prosaic a thing as a ferry has been made highly profitable by re-designing. The boat in question has proved so popular with tourists that they frequently adjust their driving schedules to avoid the old style boats and get the luxury ride on the new one.

It is this commercial success of modern designed products, repeated again and again, which has furthered the profession of industrial designing and given it a secure place in the manufacturing world. There are very few people who question any longer that modern design has a commercial value, but there are still some who wonder whether it is transitory.

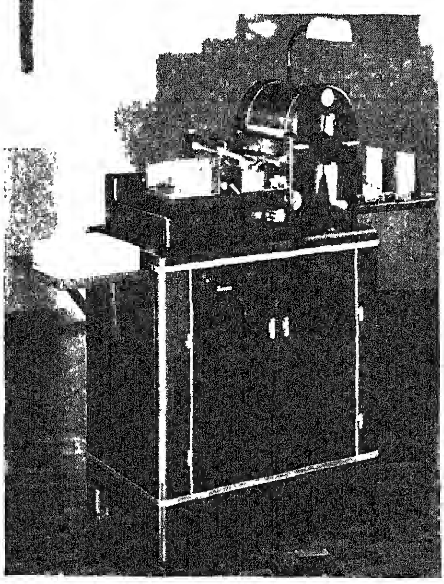
NO such query could arise if industrial designing were fully understood, if its roots were seen and its dynamism felt. There is a perfectly sound reason why it should come to full expression right now. It was a logical growth, as we shall attempt to show, and this in turn will provide a hint as to its destination.

Modern design is distinctly characteristic of this age. It is a reflection of our way of living and our attitude towards life. What distinguishes it from the design of other and earlier periods is its application to mass-produced items. We have always had modern design, though it was not so called. Today's modern design gives full consideration to the machine as the agent of production as contrasted to handicraft. It is frankly and unashamedly exploiting the potentialities of the machine which has given us things in abundance.

The development of modern design has traced scarcely 10 years. Perhaps the first step is expressed as well as any way by that advertising slogan which said: "We couldn't improve the product, so we improved the box." The verity of the slogan may be questioned, but in such a statement lies the idea that when technical problems have been pretty well solved, attention should be given to appearance. Modern design of mass-production items is in reality a complement to production achievements, because products became so uniformly good in their operation that a new element was needed for competition. Appearance provided it. You no longer look under the hood of an automobile before deciding to purchase; you ex-



Mimeograph machine before and after re-designing, an example of built-in design involving basic changes in mechanism. Result: A new product



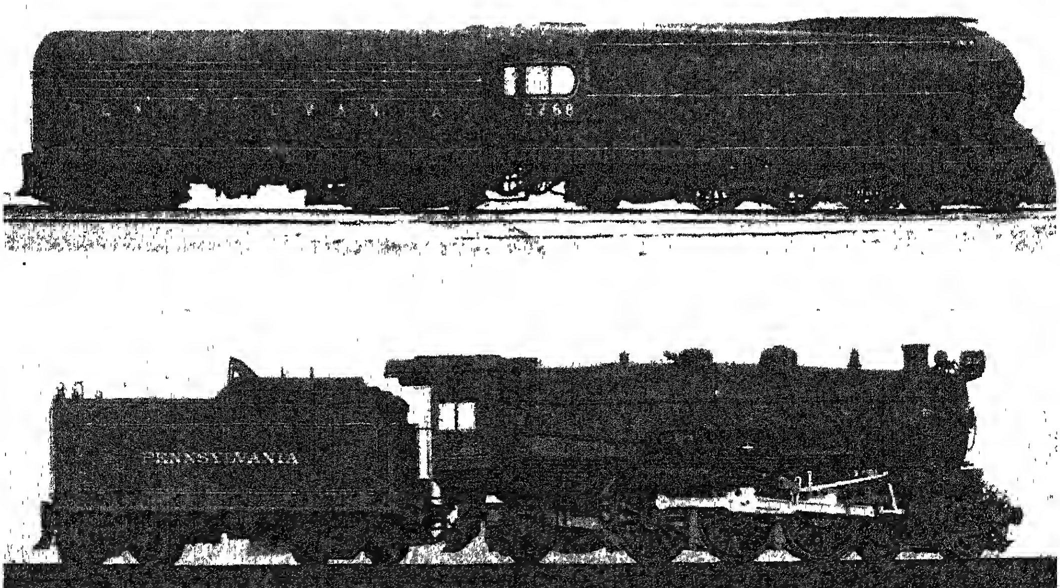
amine the upholstery and fuss about the color schemes. Much the same shift in attention applies to other consumer products today. Manufacturers now compete to catch your eye.

This new element of competition supplies the fuel to keep design fires burning and it is a fact which provides about all the proof we need that modern design is here to stay. When re-designing causes a product to jump out of line and forge ahead in volume of sales, there is little left for competing manufacturers to do but strive hot-footed for an even better design. This makes designing dynamic.

The basic aim of all design is to improve the efficiency of a product. All other purposes are incidental to this. When it is achieved, appearance will be improved and sales will mount. The product may be more expensive to make in its new dress, or it may be cheaper; it may weigh more or it may weigh less—the basic purpose is sales and this is true whether the sale is to be tickets on a railroad, the cake in a bake shop, or a vacuum cleaner. Such advantages as reduction of weight and upkeep expense, the use of more durable materials, and lower manufacturing cost are incorporated in the design as best possible.

A CHAIN of bake shops was recently re-designed with such success that the cost of store alterations was repaid within a year's time. An important factor in the ultimate success was the determination in advance of design of what it was that led customers to buy. It was discovered that a fulsome display of frosting could achieve wonders in getting people to enter a store. To increase the amount of such food on display was not a suitable solution because bake shops wish to keep stock at a minimum. Accordingly, mirrors were placed behind the display shelves at such an angle that they reflected the frostings to the passer-by, thereby doubling the display without addition to stock.

Every product which comes up for design consideration presents a unique problem and a different combination of purposes to be sought. It may require use of new materials to achieve the desired end, or it may need a re-designing of the inner mechanism. In the case of a well-known vacuum cleaner, the weight was reduced about three pounds through the use of magnesium alloy die castings and plastics. Another product, a mechanical refrigerator, which has won phenomenal sales success, features, among other things, a grill at the base where experience showed the enamel was most commonly injured, and a latch so placed that it is out of reach of youngsters. But to achieve the harmonious whole required a going over of the entire




In the newer concept of railroading, streamlining plays an important rôle for operating efficiency, but also for the sake of appearance. Here we see a "before and after" of a steam locomotive. The fin above smoke stack deflects smoke

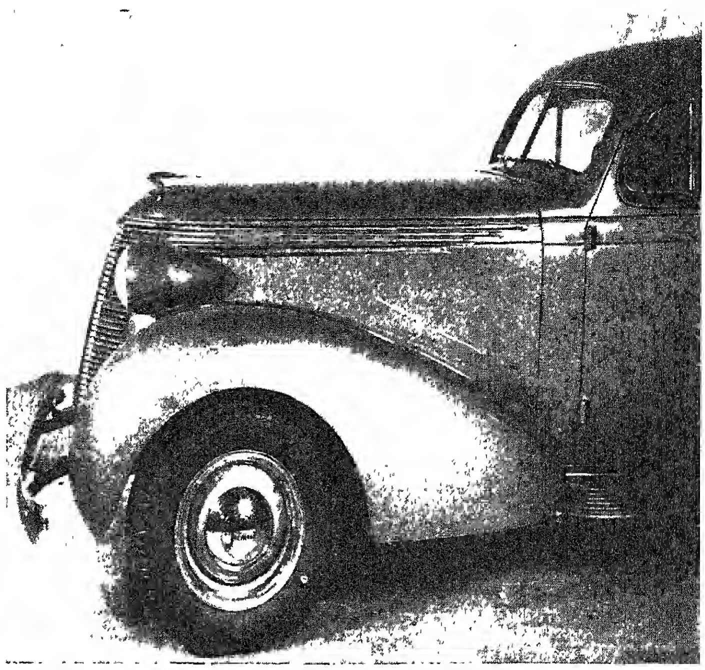
product from the standpoint of design.

Such designs are not made over-night. In fact, most of the highly successful products represent months and years of persistent work. A mimeograph machine, which has just been revealed to public view, illustrates this type of long-term designing. The smooth exterior lines, the simplicity and harmony, are not grafted on, but built in. The "works" have all undergone design treatment to make a strictly up-to-date and new product.

A similar building-in of design is found in a new portable X-ray machine, just going on the market. Here one of the many problems was to get better radiographic performance and the utmost in flexibility while retaining compactness and relatively light weight. To accomplish it meant laborious research to get better transformer design, improved insulating materials, and superior X-ray tubes. Design thought carried through from the basic materials to the final dress, so that the public sees the result as a sturdy, attractive machine, or as three zipper-tailored bags going to a patient's bedside.

Streamlining (which is a word so overworked that one hesitates to use it) probably tops all other designs in public interest, yet there are very few streamlined products in the true sense of the word. Unless an object has to encounter air currents, streamlines have no place. When the phrase is used to describe a saucepan, it is a misnomer. The true streamline has its highest development in the airplane where air friction must be reduced at almost any cost. Aircraft display modern design without parallel and for the reason that there was no tradition to overcome and the purely functional could be pursued relentlessly.

Automobiles and locomotives have broken very sharply with tradition in design, but both could be improved greatly with tradition entirely out of the picture. These two products present quite different design problems from the airplane when it comes to streamlining. If either were to be designed wholly from the standpoint of reducing frontal wind resistance to the minimum, they would probably meet with disaster, the reason being that they, unlike the airplane, have to take cross winds into consideration.



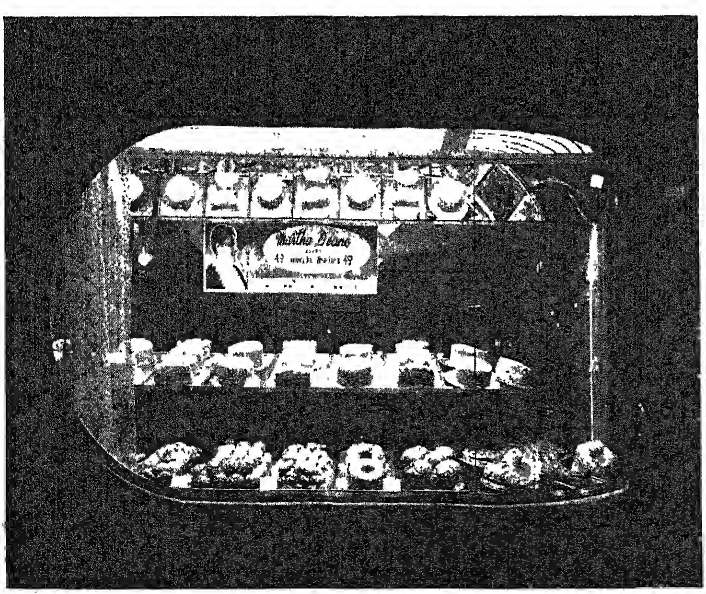
**An exemplification of streamlining, variations of which are found on most modern motor cars. The flowing lines suggest power, the fleetness of the wind**

**Magnesium alloy die castings plus plastics cut weight, enhance design**

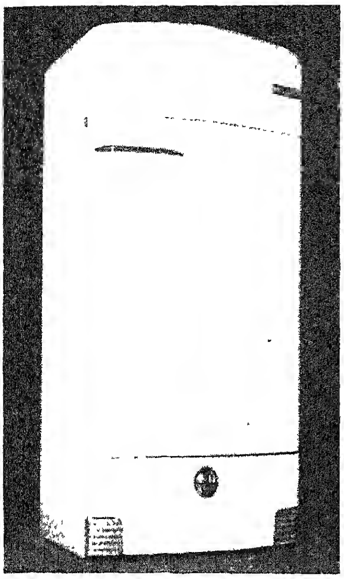
AN enormous amount of engineering has gone into the modern locomotive and streamlined train. In designing an exterior for a steam locomotive now in use by one of the large roads, exhaustive wind-tunnel tests preceded any work on paper. By the use of clay models, the factor of wind resistance could be studied in detail. Strange to relate, one of the most vexing problems was to get a satisfactory design from the appearance standpoint which would at the same time deflect the smoke above the engineer's cab. After many experiments, a solution was found in a fin, or wing-like structure.

It might be thought that the streamlining of a train could be handled satisfactorily by a simple treatment of the nose and tail, but actually skin friction is a greater deterrent to speed than head resistance when a train is long. Here again, wind-tunnel tests are used to reveal air currents set in motion by small projections.

If industrial designers employ any particular theories in their work, they will not admit it. The most famous exponents of the art declare that the essentials to success are an open mind as



**The front of a bake shop. Mirrors double the view of cake frosting in the window. Sales in such stores increased rapidly after they were re-designed**



The refrigerator which was designed for service as well as appearance

well as designing ability. Engineering training can be enormously helpful, but if a designer does not have it, its advantages can be had from staff men either in his own organization or in the concern for which he is designing. Competency requires a very complete knowledge of materials—their possibilities and limitations—and a comprehension of what is being done in all fields. But if designers will not admit to theories, they do hold to a definite technique in approaching a design problem. The technique of different designers may vary, but there is a striking similarity none the less, and it is well worth examining how they work because it reveals much about the art.

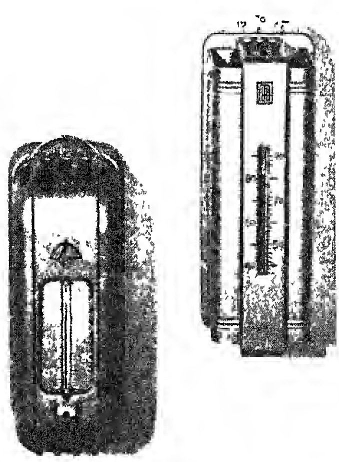
ONE of the most prominent designers declares that there are three objectives in making a problem more desirable and hence a bigger seller. These aims are: improving the appearance, improving serviceability, and increasing economy. Of the first aim he says:

"Appearance must be built in and not applied; has nothing to do with decoration; is essentially a look of efficiency, competence, stability, durability, simplicity, and honesty, revealed with grace and charm." Appearance is "placed first because efficiency and economy are primarily the engineer's responsibility, but the designer must also achieve them."

Economy is striven for but is rarely the prime consideration of modern design. It sometimes happens that the cost of making a product is lowered by re-designing, but this is incidental to getting the best design possible. What the designer expects is to produce a product which will sell in a volume more than sufficient to offset any factor of higher cost. When he succeeds, you find examples like the one of the gas range which sold in 300 percent greater volume in six months, although prices were 15 percent higher; and the re-designed gas heater which established a 400 percent sales increase within a year, despite a 12 percent higher sales price. In both these cases the attractiveness of the product drew to the fold retailers who hitherto had refused to carry the lines.

There have been instances where the simple fact of re-designing has lifted a product out of its competitive class and placed it in a position where any competition was negligible, even with cost and sales prices advanced.

When aims have been established, the next consideration is the method to be employed to attain them. This involves preparatory study to become thoroughly acquainted with the use of the product, the way it is now being made—that is, its structure—and finally with the manufacturer's facilities. Still other studies must be made of sales and competition. The public will accept some things and not others. Therefore, if a design is to be successful, it must be executed



Mechanical limitations of space and form were factors in this design

with full understanding of what it has to face when it is released to the consumer.

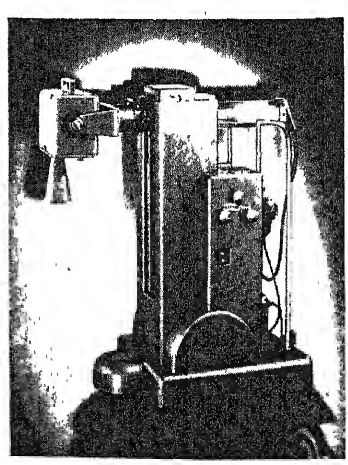
Once a factual background has been obtained, the mechanics of designing can begin. Many drawings will be made and these will be followed by models which can be studied to see how well they achieve their purpose. When a design is settled upon, it must not only represent the basic aim, but be capable of being produced with available plant facilities or such new equipment as the manufacturer feels is justified. Essentially, then, designing becomes a co-operative endeavor between designer and producer.

It may be asked why industrial design is not undertaken by the engineering and designing staffs of manufacturing concerns? Is it necessary to go outside for talent? Staff-designed products are issuing from plants every day of the year, but the outstanding commercial successes, which have made modern design a striking feature of contemporary products, are the work of specialists in the field. The reasons for this are not far to seek. The rank outsider brings a fresh viewpoint. He comes to the problem armed with a broad knowledge of what has been done in other fields. The staff engineer or designer, on the other hand, is often too well acquainted with limitations; long association has schooled him in what cannot be done and his vision too often has become narrowed. What modern designing demands is freedom to express the machine age as we see and feel it. The slavish adding to, or subtracting from, long established designs will not achieve a similar result.

IF it is true that the machine has ushered in a new era, and there seems to be little doubt about it, then modern design is here to stay because the machine will continue to serve us. Design will not remain static, but will alter slowly in accordance with development of the machine conception. Any professional designer can sit down and sketch out his idea of the refrigerator, the automobile, or the radio of the future, to suggest the lines of progress. The ultimate has not and never will be reached. Progress is of necessity slow, and particularly in those fields in which tradition is strongest, such as housing and interior decoration.

At the moment, modern design forges steadily ahead because it pays in dollars and cents. The manufacturer adopts it because he cannot ignore a vital commercial success, not from altruistic or esthetic reasons. Competition has become, therefore, the life of modern design.

Photographs courtesy of: The Hoover Co., Minneapolis-Honeywell Regulator Co.—Henry Dreyfuss, designer; Revere Copper & Brass, Inc., The Studebaker Corp.—Helen Dryden, designer; Cushman Bakery, Pennsylvania Railroad, Princess Anne Bay Steamer, Sears Roebuck & Co.—Raymond Loewy, designer; A. B. Dick Co., Westinghouse X-Ray Co.—Walter Dorwin Teague, designer.



Appearance was an integral part of the design of this X-ray machine

# OUR POINT OF VIEW

### Air Crashes

IS the pilot to blame for the crash of his airplane? Crash investigations of the Department of Commerce more often than not find in the affirmative—when the pilot is not alive to tell his story! In fact, out of 27 recent airplane accidents, 16 were blamed on pilot-error.

Why this high percentage? Would it be radically lowered if the pilots could speak for themselves from the grave? Or is it due to the fact that, as has been declared, every member of the investigating board is a "party in interest"? Does politics have as much to do with the findings as has been claimed?

At present, no one knows the answers to these questions. We can, however, be rather positive on one point: Pilots are not so generally to blame as we are asked to believe. Air-line pilots, in addition to being average human beings like you and me, who own their homes and have families and have as much desire to go on living as the rest of us, are highly trained, carefully picked, professional men. It is not reasonable to believe that they take any more chances than an equally expert automobile driver of long years experience. Yet that automobile driver has probably had his engine die for various reasons a number of times; if he had been piloting a plane, such engine or equipment failure would have meant disaster. Yet the pilot must rely, for the perfect functioning of his plane, not so much upon himself as upon a host of others.

No; the pilot is surely less often at fault. The blame may actually lie in several directions but when no definite clue can be found, it is easy enough to say that the pilot must have erred. This is easiest for the operator, for the plane and engine manufacturers, for the Department of Commerce—all prejudiced parties to any crash-investigation. And the Department of Commerce, having approved plane and equipment, supervised operation, built and maintained airway beams and other safety and operational features, and having made all the air rules and regulations, sits as judge and jury in the investigation!

Congress had before it, in the spring, legislation that would take air transportation out of politics, put it under a separate section of the non-political Interstate Commerce Commission. Air-line pilots think that within this section there should be created a five-man Air Safety Board (not political appointees) whose sole purpose would be to consider first, last, and all the time the safety of air travelers. With such a set-up, and especially in view of the Interstate Commerce Commission's past record, it is the honest opinion of many that a great advance in air safety can be made. If such is the case, all those interested in the air lines should heartily endorse both the legislation and the pilots' suggestion for the Air Safety Board. So far they seem to comprise the best solution to an important problem that has come to our notice.

### Trailer Troubles

ALTHOUGH the development of the house trailer has not lived up to the expectations of certain optimistic prophets, still its growth has been ample to bring in its wake a series of troubles that cannot be overlooked if even more serious difficulties are to be avoided in the future. In the reports from those who have tried life on the open road with a trailer—whether the trailer be used for vacation trips or as a permanent home—we find a great diversity of opinion regarding the desirable features of this method of living. Possibly the greatest drawback to trailer travel today is the lack of satisfactory and safe camping facilities. It is all very well to talk about "pulling up alongside the road wherever night overtakes us" but actual practice is a far different matter. Certain conveniences must be available if life in a trailer is to be anything more than a succession of bad dreams. First and foremost, there must be available an adequate supply of pure water. Second, there must be some type of sewage disposal. It is these two points in particular that must be very carefully worked out if a trailer camp is to be comfortable for its users and safe for the country at large. An epidemic starting in a trailer camp could spread to the four winds with incredible rapidity. As soon as a case of communicable disease breaks out in such a camp, there can be no doubt that every member of that camp will leave in haste, possibly acting as a carrier of the disease and spreading it throughout the country.

The "footloose and fancy-free" character of trailer travel lends itself admirably to the spread of contagion and not at all to checking it. Departing from a camp at dawn, a trailer and its occupants may well be 400 miles away by dark, ready to settle down in another camp for the night. Unless some system of registration is employed, other than a possible casual check on license plates, there is no way of knowing whence came the trailer or whither it may be going.

A trailer camp can be a decided asset to a community, but unless it is properly planned and the plans are adequately carried out, it can be a decided detriment. Some of the camps now available in Florida and California—to cite only two examples—are indeed worthy of study by any community planning to develop such a camp. In any event, such a development is not a thing which should be gone into without serious consideration of all the problems involved, and without provision for the health and comfort of those trailerites who will be the guests—and paying guests, at that—of the community in the future.

### Teach Taxation

IGNORANCE of the very fundamentals of the taxation system is so widespread as to be appalling, particularly in view of the activities of the present administration and the amount of space devoted to the subject in the daily press. It is not at all uncommon to hear, during a discussion of some piece of public work, the statement made by an otherwise intelligent and well-educated person that: "This work is being paid for by the Government; the money does not come out of my pocket."

It is not the purpose of this discussion to attempt to delve into the ramifications of hidden taxes that hit the pocketbooks of each and every individual in the country, regardless of age or financial position. Rather, it is to make a plea for more general education in the simple fundamentals of taxation. If in every school throughout the country there could be instituted a simplified course in the principles of taxation, such a course to be compulsory with every student, it would be possible to lay the foundation for a far better understanding of such functions of the Government—and from such understanding would grow a greater interest in, and hence a more careful selection of, our public officials by the voting body.

With such knowledge inculcated in each successive generation, the citizens of the country would be in a far better position to dictate the course of government, rather than leave such dictation in the hands of a few politicians who take advantage of the ignorance of those who elect them to office, and then turn to their own advantage public funds which are made up entirely of moneys contributed by those who put these same officials into positions of trust and who keep them there.

# TWINS

By D. CECIL RIFE, Ph.D.
Department of Zoology and Entomology, Ohio State University

WHILE walking along the street one day, I spied the familiar form of a young man a short distance ahead of me. Catching up with him, I spoke and attempted to start a conversation, being certain he was an acquaintance. However, he acted very peculiarly, as if I were a stranger. Finally he said: "You must be mistaking me for my twin brother." His statement was correct, and subsequent tests of the twins revealed that there was only one chance in a quarter million that these young men could have been so similar in regard to certain traits, if they had not originated from the same fertilized egg cell. In other words, they were, almost beyond the shadow of a doubt, monozygotic or so-called identical twins.

The above-mentioned tests constitute a twin diagnostic formula developed in the genetic laboratories at Ohio State University, and include blood group, finger patterns, eye color, stature, certain taste reactions, and I.Q. The twins are compared with each other, and with their parents and brothers and sisters in respect to each trait. The chances of the twins being so similar if they originated from different fertilized egg cells are then computed.

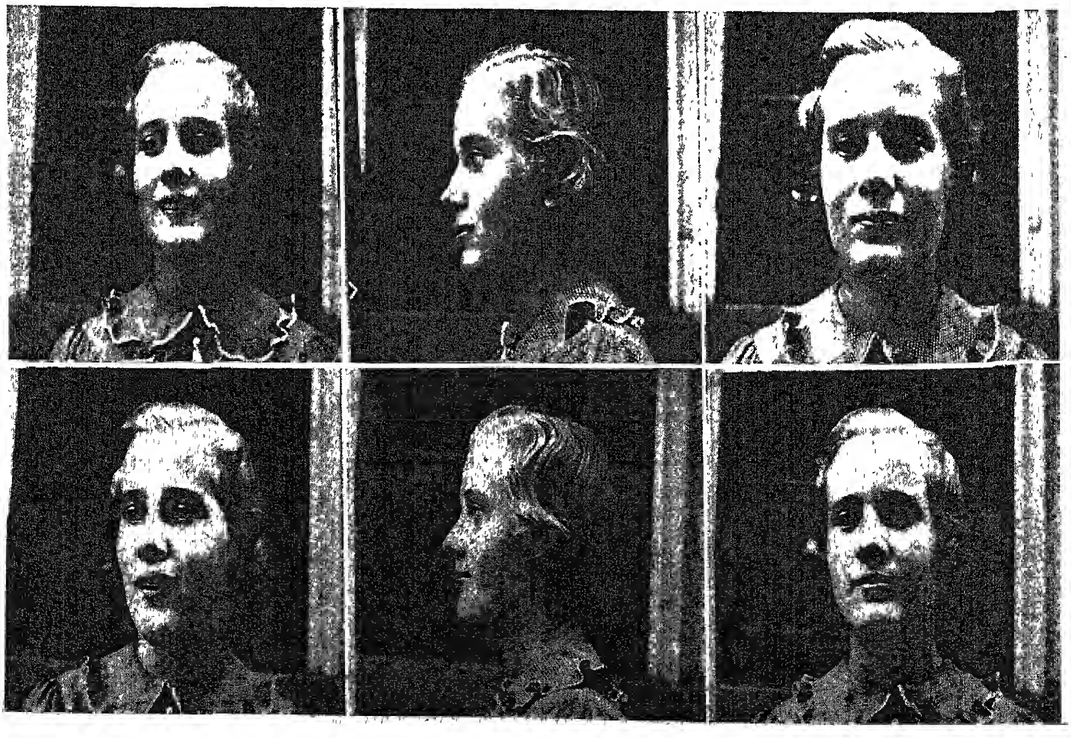
The previously discussed young men belong to the same blood group, have no noticeable differences in hair or eye color, vary less than a quarter inch in stature and a pound in weight, and have finger patterns so similar that only an expert can distinguish between them. Both are red-green colorblind, to exactly the same degree. They sometimes sing duets, one tenor and the other bass. Occasionally, while singing, one will nudge the other, and they will exchange parts, very few of the audience being aware of the change. According to the Stanford-Binet test, they have the same I.Q. At the age of 20 each was bothered with a toothache, the troublesome teeth corresponding exactly in position. Each went to a different dentist, but in both instances the tooth was filled.

ALMOST everyone knows of identical twins, and similarities such as we have mentioned are not at all uncommon. While there is always a chance that any particular pair of extremely similar like-sexed twins did not originate from the same fertilized egg cell, the odds are many thousands to one against such a possibility. You can be reasonably sure that twins who are so similar as to be constantly confused by relatives, teachers, and friends are actually monozygotic or identical (the latter term being literally correct for genetic makeup alone).

The illustrations on these pages show a pair of identical twin girls studied in our laboratories. When five years of age they were operated on for appendicitis, within two days of each other. Their appendices, when removed, were found to be of practically the same size and in the same condition. There are six pictures of each girl, each vertical pair of pictures showing both girls. However, the same girl is not always in the top or bottom row. See if you can find which pictures are of the same girl, marking one *A* and the other *B*. A key is given at the end of this article.

About 20 to 25 percent of human twins are identical. Fraternal twins are derived from different fertilized eggs, and are no more alike in hereditary makeup than brothers and sisters. Triplets, quadruplets, and quintuplets may consist of all identical, or various combinations of identical and fraternal individuals. Siamese twins are identical twins that have not completely separated.

The occurrence of these two types of human twins gives us unparalleled material for the investigation of the relative importance of heredity and environment in the development of various



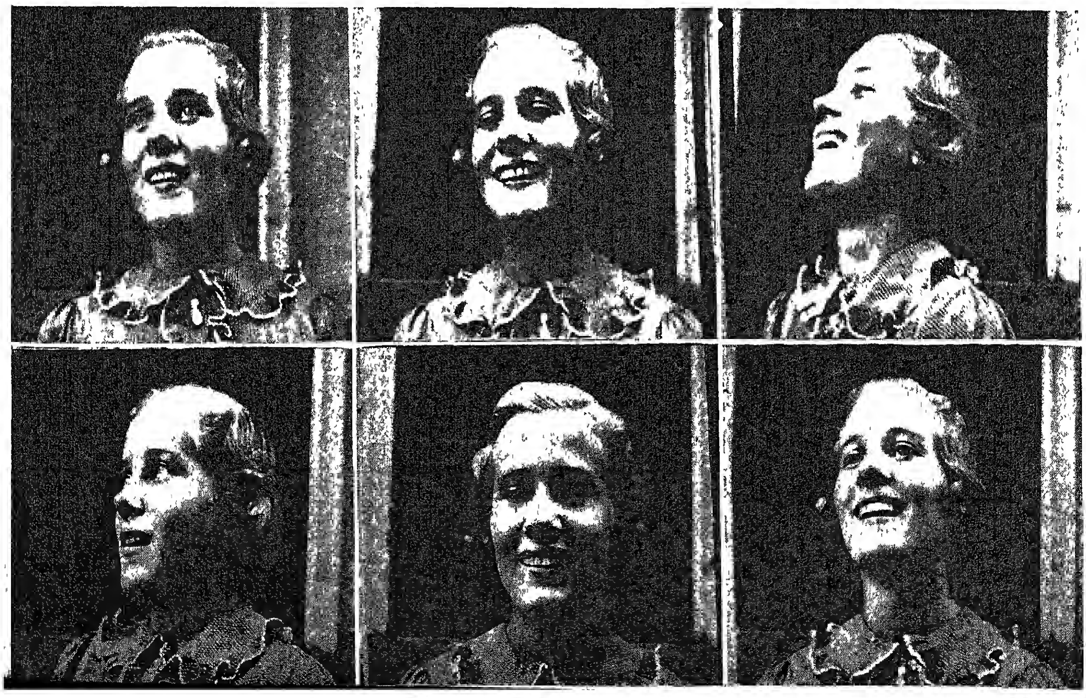
## To the Science of Genetics, Having to do with the Effects of the Different Materials Received from our Parents, Twins are an Invaluable Aid, Revealing Much Concerning the Oft-debated Question of the Effects of Heredity and Environment

traits. Any differences which occur in a pair of identical twins must be due to factors other than hereditary makeup. If identical twin brothers should marry identical twin sisters, any resulting double cousins would be as similar in genetic makeup as ordinary brothers and sisters. It does not necessarily follow that traits which occasionally show intra-pair differences in identical twins may not have a hereditary basis. Reversal in handedness, for example, occurs in some, but not in the majority of identical twins, yet there is evidence that handedness has a genetic basis. The explanation for this phenomenon lies in the fact that the prenatal environment of identical twins is different from that of single born individuals, and the position *in utero* may counter-balance the inherent tendency. Fraternal twins give us controls for our identical twin investigations, as, broadly speaking, twins reared together have similar environments. Those similarities which are greater in identical than in fraternal twins must have a genetic basis, provided the two groups of twins have equal environmental similarities. It should be remembered, however, that fraternal twins, while not having identical hereditary potentialities, are as similar as brothers and sisters. Thus, by comparing the two types of twins in similar environments, we obtain only a partial measure of the part played by hereditary factors.

Numerous scientists have taken advantage of this method of research. For example, Diehl and von Verschuer, of Germany, have just completed a study, covering a period of years, of 205 pairs of twins with tubercular tendencies in one or both members of the pair. Of these. 80 pairs were identical and 125 pairs fraternal. The identical twins showed similar tubercular tendencies in *both* members of the pair in 80 percent of the cases, whereas among the fraternal twins such similarities were observed in only 25 percent of the cases. Such findings definitely establish the existence of genetic differences in susceptibility to tuberculosis, although infection is of course necessary before anyone can contract the disease.

MANY diseases have been investigated in a similar manner by various scientists. Certain types of hernia, goiter, epilepsy, and dementia praecox, show a high degree of intra-pair correspondence in identical twins, and low correspondence in fraternal twins, indicating that heredity is an important factor in their occurrence. On the other hand, measles and whooping cough show about the same frequencies of intra-pair correspondence in both types of twins, indicating that genetic makeup has little to do with an individual's susceptibility to these diseases.

Numerous striking similarities for less common diseases have been reported and observed in identical twins. We recently discovered a pair of identical twin men, 52 years of age. For 25 years they have lived apart at a distance of approximately 100 miles. One is a railway engineman, the other a dock worker. One day in April, 1933, the railway engineman became ill and was operated on for gall stones at 6:00 P.M. About midnight of the same day, his twin brother became ill, and was also operated on for gall stones. Less than a year ago a well known magazine reported a similar case in regard to cancer of the stomach. A man over 70 years of age became ill and was taken to a hospital. Diagnosis revealed that he was suffering from cancer of the stomach. Within less than a week his identical twin brother, who lived some distance away and knew nothing of his brother's condition, likewise became ill and was sent to a hospital. It was found that he, too, was suffering from cancer of the stomach. Obviously, such similarities in twins in later life, after years of separation, are more significant than when occurring in twins who have always lived together. Particularly enlightening is the following case, reported by Champlin in 1930, for the *Journal of the American Medical Association:* One member of a pair of identical twin boys was struck with a board, and subsequently developed sarcoma of the right testis at the age of 24, and died two years later. His brother had no such



injury, but developed sarcoma of the right testis at the age of 31. Thus the injury apparently did not cause the sarcoma, but simply hastened its onset.

Of especial interest are twin comparisons in regard to mental deficiency. In identical twin pairs, in which one member of the pair was feeble-minded, the other member was also found to be deficient in approximately 96 percent of the cases, whereas in fraternal twins both members of the pair were affected in only about 25 percent of the cases.

Several years ago, Lange, in Germany, studied twins from the standpoint of criminal tendencies. Of 13 cases of identical twins, where one of the members of a pair had a criminal record, in all but three pairs the other member also had a criminal record. Only three out of 18 pairs of fraternal twins showed similar criminal tendencies in both members of the pair. These results were so significant that similar comparisons were made by later investigators. A total of 66 pairs of identical, and 84 pairs of fraternal twins have been included. In 68 percent of the identical twins, both members of the pair had criminal records, whereas both members of fraternal pairs had criminal records in only 38 percent of the cases.

A number of anthropological traits, such as blood group, hair color, eye color, skin pigmentation, and various hereditary abnormalities, including polydactylism, albinism, harelip, pattern baldness, and colorblindness, never show intra-pair variation in identical twins. Finger and palm patterns, tooth conformation, features, gait, voice, and mannerisms never show great intra-pair differences in identical twins, but may or may not show considerable variation in fraternal twins. In some but not all cases, of identical twins, the finger and palm patterns of the two right hands, and of the two left hands, of the pair are more similar than those of the right and left hand of the same individual.

THE most fascinating phases of twin comparisons are, to the majority of us, those having to do with intellectual traits. The relative importance of heredity and environment in mental makeup has been for centuries, and still is, a topic sure to arouse a lively discussion in most groups of civilized mankind. Have twin studies shed any light on this question?

Considerable research has been done in this field, by numerous investigators. There are certain difficulties, however, which are not often encountered in the study of physical traits. We cannot be sure whether a given mental test measures only innate learning capacity, or whether part of the responses are the result of education and training. Then, too, the person tested may or may not respond to the best of his ability. There are certain tests, however, such as the Simon-Binet and its revisions, which have been thoroughly studied by psychologists over a period of years, and have been shown to be fairly valid measures of general learning capacity. When administered by trained testers, they have high coefficients of reliability. In other words, testers working independently usually obtain very nearly the same I.Q. for any particular individual, or if the individual is tested at intervals of several months or years, the I.Q. remains practically the same.

HUNDREDS of twins reared together have been given general intelligence tests, by various investigators. The average intra-pair difference obtained for identical twins is approximately five points in I.Q., an insignificant figure. On the other hand, fraternal twins show, on an average, intra-pair differences of from 10 to 12 points, which is a significant difference. The obvious conclusion from such results is that intelligence is, to some degree at least, dependent upon genetic makeup. Newman, in an attempt to determine to what extent environmental factors modify intelligence, has recently studied 20 pairs of identical twins reared apart, and finds that their intra-pair differences in I.Q. average about the same as those for fraternal twins reared together. The outstanding inference from such findings seems to be that heredity and environment are of about equal importance in determining an individual's I.Q. There are, however, some obstacles to a final acceptance of such an interpretation. Similar and dissimilar environments, are, after all, only relative terms. No two individuals ever have absolutely the same or totally different environments. Critics quickly point out that, even when both types of twins are reared together, the identical twins have more similar environments, because only close relatives and acquaintances can ordinarily distinguish between the members of a pair, and they are thus treated as a single personality. Fraternal twins are as unlike as ordinary brothers and sisters, and people react to each differently.

A logical method of ascertaining the merits of such a contention would be to obtain intra-pair comparisons of a fourth group—fraternal twins reared apart. Such comparisons would also be valuable as a final check on the other groups. If such measurements should show greater differences between the identical and fraternal twins reared together, than between those reared apart, we could safely assume this discrepancy to be due to the fact that identical twins reared together have more similar environments than fraternal twins reared together, as the genetic differences should be practically the same in both instances. If, however, the two types of twins, when reared apart, should show the same or greater differences than those reared together, we could assume the environmental differences of the two types of twins reared together to be insignificant from the standpoint of intellectual makeup.

IT is possible for two individuals to make the same scores on an intelligence test, such as the Simon-Binet, and yet to answer different parts of the test, or give different correct answers for the same parts. Anyone who has had much experience in testing twins knows that, when members of a pair of fraternal twins make the same total scores, they usually show differences in parts answered correctly; or, when both answer a certain part correctly, they are likely to do so in different manners, whereas identical twins show an amazing similarity in parts answered correctly, and in type of answers. Statistical comparisons have shown that there is a significant difference in the degree of similarity of responses in the two types of twins. In other words, identical twins reared together show qualitatively greater intra-pair similarities in type of responses than do fraternal twins reared together. We do not know whether the greater similarities encountered in identical twins are due to their having more similar environments than fraternal twins reared together, or to there being a genetic basis for the kind or quality as well as the total amount of intelligence measured by such tests. A comparison of fraternal twins reared apart with identical twins reared apart should give us the solution. If the same qualitative differences are found to exist between the two types of twins reared apart, then we can be quite certain that the kind as well as the total amount of one's intelligence is, at least partially, determined by heredity, whereas if such differences no longer exist between the two types of twins reared apart, we can assume the qualitative discrepancy between twins reared together to be due to the greater similarities in the environments of the identical twins.

We have briefly outlined some of the advantages of the twin method of genetic research. It can readily be seen that we have only begun to take advantage of the possibilities. Any one knowing of twins reared apart, either identical or fraternal, will be rendering a real aid to genetic research by contacting interested investigators.

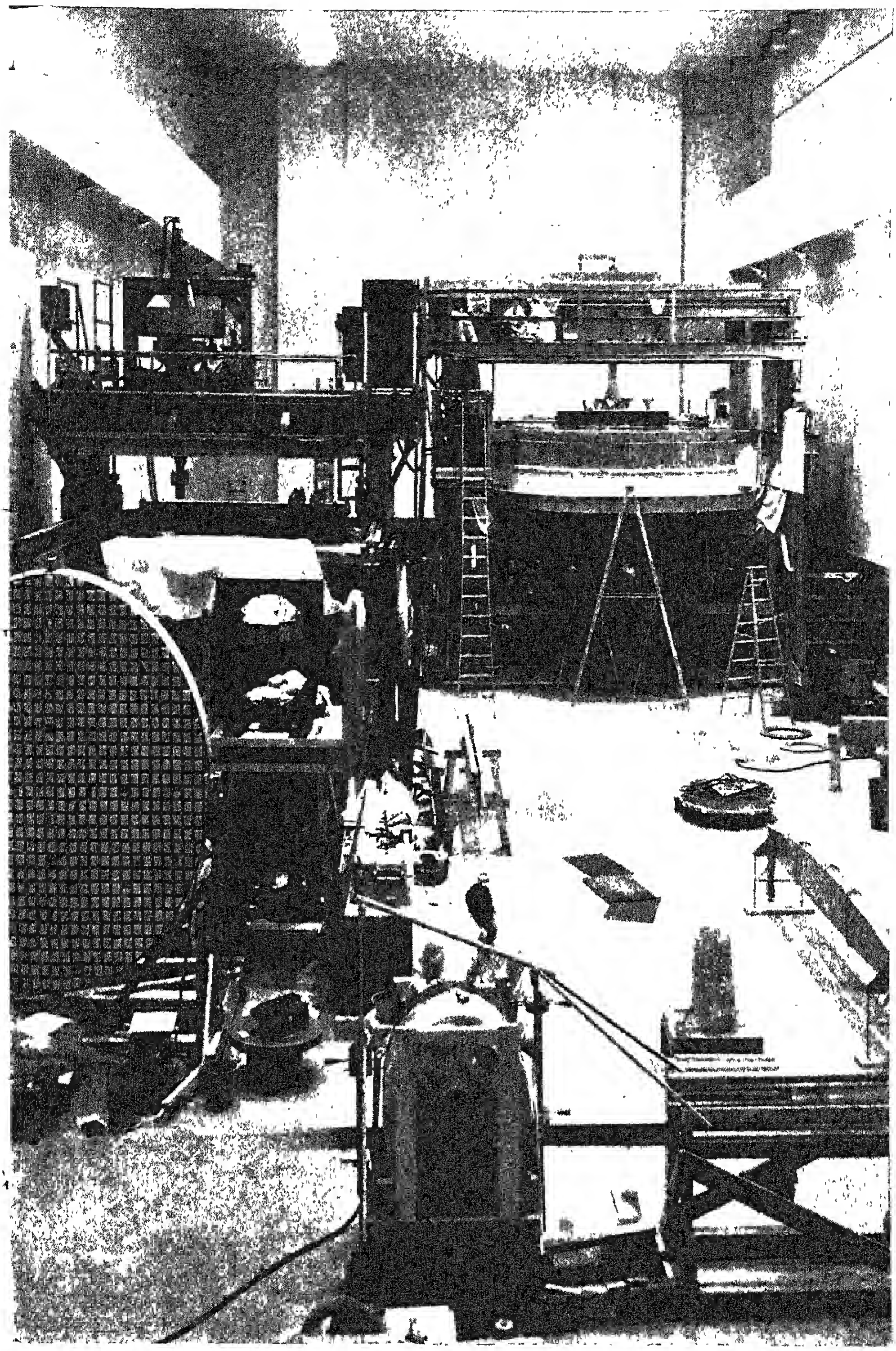
●

*Key to illustrations on pages 74-75:*

*If we use* A *to represent the twin shown in the first picture in the top row and* B *to represent the twin shown in the first picture in the bottom row, then the order is as follows:*

*Top Row:* A—B—B—A—A—B

*Bottom Row:* B—A—A—B—B—A



## The 200-inch Telescope Mirror Disk Under Initial Work

CONTRARY to a widespread impression, the 200-inch mirror disk, by the press often mistermed a "lens," which was made for the great California telescope, was not ready for use when shipped from Corning, New York, to Pasadena, but was simply a cast blank of glass, as ordered. The longer work of the opticians mainly remains to be done. If all goes well this lengthy precision job should be finished by 1940.

The photograph shown above was taken from the visitor's gallery at one end of the 162-foot Optical Shop at the California Institute of Technology, by Macpherson Hole, Jr., and sent by Wilson Hole. Its main feature is the big disk showing at right, just above the large A-shaped ladder. It lies on its face for the time, slowly rotating while two men seen in the bridge above it pour down abrasive grains. A tool which also rotates as it crawls back and forth across the disk, gradually reduces its back to a level surface. This is tested by means of a stretched piano wire, on a beam showing in the right foreground—a sufficiently precise method for the back.

Tipped up at the left is a glass-faceted grinding tool 120 inches in diameter, and behind it on its own grinding machine and covered with a white cloth is a 120-inch optical flat. This was made for testing the still larger mirror after it has been turned over, ground to a curve nearly four inches deep, fine-ground, polished, and delicately "figured" within one millionth inch of perfection. Nor could all the king's money, men or machines speed up this long process of utmost refinement.

# OLD PROBLEM—NEW PROGRESS

## How a Century-old Obstacle Has Been Avoided in Dealing with the Astronomer's "Problem of Three Bodies"... Special Problem Just Solved

By HENRY NORRIS RUSSELL, Ph. D.

Chairman of the Department of Astronomy and Director of the Observatory at Princeton University. Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington. President of the American Astronomical Society

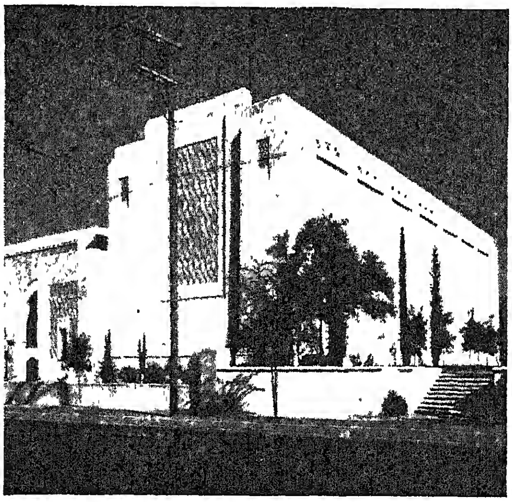
ASTRONOMICAL calculations are a literary byword—everyone knows that they are of vast intricacy. A good many of us have heard that some of the worst of them deal with mysterious things called "perturbations"—but fewer of us could tell much more about them.

The trouble with the astronomers is that they can make their observations with great accuracy (which has itself become a byword); and they naturally want to predict the motions of the bodies which they observe at least as accurately as they can measure them.

This would be no trouble at all if we had to deal with only two bodies at a time—such as a planet going around the sun. Under the sun's gravitational attraction, it would pursue a fixed elliptical orbit, returning to the same place at exactly equal intervals. If the orbit were a circle, it would move uniformly in it, and prediction would be child's play. The more eccentric the orbit, the more uneven the motion; but the position at any time may still be calculated by formulas workable by anyone who knows a bit of trigonometry.

With three bodies present—say Jupiter, Saturn, and the sun—the problem becomes extraordinarily complex. More than a century of study by the most competent mathematicians has made it certain that, if any general formula could be obtained to take care of the case of any three bodies (whatever their masses and motions) it would be so intricate that it would be of no practical use at all for numerical calculation. Fortunately for the astronomers, they have to deal with cases of special types, in which solutions can be obtained by a succession of approximations.

THE planets, for example, are so small compared with the sun that the attraction of one upon another is never as great as a hundredth part of the sun's attraction on it, and usually very much less. We start, then, by treating the motion of Saturn as if Jupiter were not there, and vice versa. This gives formulas for their motions (each in a fixed orbit) from which their positions can be approximately, though not exactly, calculated. Using these computed positions, we may now calculate the attraction of each upon the other, and then find the changes which their attractions will produce in their motions. These changes are the "perturbations." To compute them is by no means a simple problem, but one that has been solved. Armed with this information, and correcting our original calculations of the planets' positions at a given moment for the perturbations, we can use these corrected positions to get improved values of the perturbing forces. These again lead—after a great amount of labor—to more precise values of the perturbations themselves. A third similar step is necessary only for the most massive planets, Jupiter and Saturn.



The handsome exterior of the Optical Shop on the campus at the California Institute of Technology, in Pasadena, within which the 200-inch mirror disk is now being ground—as is shown on the preceding page

The results of these vast calculations may be described rather simply. We may suppose the orbit of each planet to remain an ellipse, but very slowly to change its shape and shift its position in space—though its size and the period of revolution remain unaltered. The actual planet will never get very far from an imaginary one, which moves in this "mean ellipse" in accordance with Kepler's simple laws, though it may be nearer the sun, or farther off, ahead of the fictitious planet or behind it, above the orbit plane or below it. The amount of these deviations may be represented by the sum of a great number of "terms," each of which has a fixed range, or amplitude, and a fixed period. A single such term may be described geometrically by uniform motion in a small circle exactly like the famous epicycles by means of which Ptolemy, 1800 years ago, sought to calculate the planets' motions.

The modern "tables of the planets" indeed are a glorified collection of epicycles, far more numerous than Ptolemy's. What gravitational theory does is to enable us to calculate accurately the period and radius of each epicycle.

Theoretically, the number of these terms or epicycles is infinite; but in practice only a moderate number are large enough to have to be considered, even in the most refined work, so that the "planetary theory" is a practical success.

The lunar theory, which deals with the motion of a satellite under the attractions of its primary and the sun, differs widely in its analytical details, but ends with formulas of the same type—a slowly changing mean orbit, and a host of epicycles or periodic terms. Like the planetary theory, it succeeds in practice, though Brown has had to include almost 700 terms in his expression for the moon's longitude. But this success depends on the fact that the orbits of the planets, and of the moon, are roughly circular—having small eccentricities—and are inclined to one another by but a few degrees. The coeffi-

cient of each term (in plain words, its size) comes out of the analysis in the form of a power-series in the eccentricities and inclinations. For most of the infinite number of terms the coefficients involve such high powers of these small quantities that they are negligibly small. When precise perturbations are calculated for Pluto, with its high eccentricity and inclination, the number of "sensible" terms will probably be very large. (It will be many years before our knowledge of its orbit will be accurate enough to justify this heavy labor.)

To apply the same methods to a comet would probably be useless—it is very doubtful, to say the least, whether the series would be convergent. Fortunately, there are other, and much easier, methods for computing, as accurately as we like, the perturbations of a comet by the planets—step by step, and month by month, for as long as our patience holds out—and this suffices in practice, since no comet has yet been observed for as many as 40 returns, and only two for more than 20.

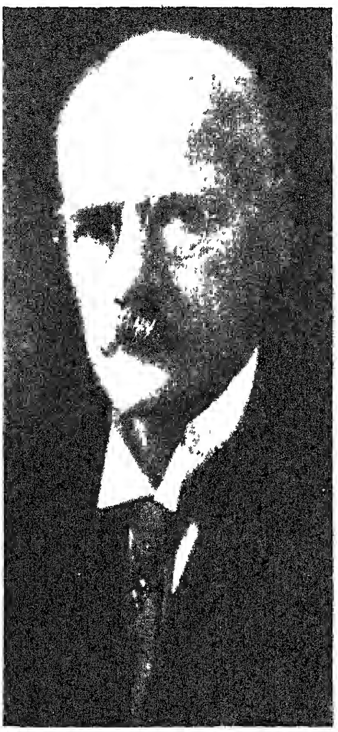
But there are other cases, of much theoretical interest, in which the step-by-step process would not work.

FOR a considerable percentage of the double stars, for which orbits have been computed, one of the components has been found to be a spectroscopic binary—a far closer double. For example, Castor consists of two close pairs, with periods of three and nine days, revolving about one another in some 300 years.

In such systems, the smaller orbit is often, and the larger one almost always, highly eccentric, so that the "classical" methods already described are not available. It is also impracticable to calculate the motion in the close pair, step by step, over thousands of revolutions.

Here is a new problem presented by nature, demanding a new method of mathematical attack, and the problem has just been solved, in a brilliant fashion, by the most experienced veteran in the field of celestial mechanics —E. W. Brown. Professor Brown starts from scratch—with the general equations of motion—but applies a new method of approximation. In all known cases of this sort the period of the close pair is but a small fraction of that of the wide pair. Call this fraction $m$. A general solution of the problem would involve terms containing $m$, $m^2$, $m^3$, and so on. A first approximation, and one quite adequate for the present purpose, may be obtained by neglecting the very small terms involving $m^2$, and so on. When this is done, he finds that the mathematical analysis is simplified to an unexpected and remarkable degree. It is no longer necessary to expand in powers of the eccentricities and inclinations; instead, general formulas are obtained, which hold good even for very large values of the eccentricities of both the large and small orbits, and of their mutual inclination.

Nothing like this has ever been met with before in the century and a half



© Bachrach

**Professor E. W. Brown of Yale, a specialist in celestial mechanics**

of past investigation. It is indeed a new case in celestial mechanics, and the most notable theoretical advance in many years.

The motion of the wide pair is not perceptibly affected by the duplicity of the close pair; but the orbit of the latter may change considerably. During each revolution of the close pair there are departures from simple elliptic motion—usually too small to be important. During each revolution of the wide pair the orbit of the close pair, and the position of the stars in this orbit, undergo periodic changes. Finally, there are slow changes. The point of closest approach of the stars (periastron) moves forward, the node of the orbit-plane on that of the larger orbit retrogrades, and both the eccentricity and inclination fluctuate by large amounts. These changes are themselves periodic, and require for their completion as many (or more) revolutions of the wide pair as there are revolutions of the close pair in one of the wide. These changes are illustrated by Professor Brown's calculations for the system of *Xi Ursae Majoris*—which has already been described in these columns. [June, 1936, page 315. —*Ed.*]

The wide pair with a period of 60 years has an eccentricity of 0.41 and an inclination of 57 degrees to the "plane of the sky" on which it appears to be projected. It has been well observed over nearly two revolutions. The brighter component is a spectroscopic binary with a period of 1.83 years and an eccentricity of 0.53. Precise photographic measures of the apparent separation of the wide pair show an oscillation which indicates that the smaller orbit is inclined 85 degrees to the "sky" and 38 degrees to the other orbit. The companion is too faint to see separately.

The other component of the wide pair is also double, with a period of four days; but this pair is so close that for all practical purposes it may be treated as a single body. The first pair, however, affords an almost ideal case for the application of the new theories. The periodic changes in the smaller orbit, which repeat themselves after 60 years, alter the eccentricity by a total range of 0.03, the inclination by 3 degrees, and the longitude in the orbit by a little over 1 degree. Could we observe the pair from close by, these changes would be conspicuous; but at its actual distance these effects are at the very limit of observation, if not beyond it.

THE gradual changes are much greater, but very slow. The forward revolution of the periastron takes 24,000 years to complete a circuit, the retrogression of the node, 4600 years. The eccentricity ranges from 0.54 to 0.19, and the mutual inclination of the orbits from 37 to 47 degrees. These changes repeat themselves after 1900 years.

Could we observe the pair long enough, we would therefore find easily observable changes. The orbit plane, in particular, may at times have an inclination—from our viewpoint—of 57–47 degrees, or only 10 degrees. At other times it may be exactly edgewise toward us, and it is possible that one star may eclipse the other. Unfortunately, this will not happen for many centuries.

Of all the known cases, this is the one in which the short period is the largest fraction of the longer one, and hence the one in which the perturbations are the greatest. For such a star as Castor, the periodic changes in the short period orbits must be far too small, and the progressive changes far too slow, to be detected by observation. In the triple star *Zeta Cancri*, a pair with a 60-year period has a slowly moving distant companion which must require several centuries for its revolution. There are several other such stars; and, when they have been followed nearly around their orbits, there will be a fine chance for the application of the present theory—which will then be some centuries away from being new. Until then, the problem may be regarded as closed. —*Princeton, N. J., June 2, 1937.*

# RAIL FREIGHT'S MODERN

## Freight Train Schedules Faster . . . Research Improves Cars . . . Shipments Protected . . . Larger Car Loads . . . Rail Service to Customer's Door

By S. T. BLEDSOE

President, The Atchison, Topeka and Santa Fe Railway Company

RAILROADING and romance are synonymous. That same unquenchable romanticism which drove bands of steel across the continent to weld millions of miles of raw territory into a mighty nation breathes today as America's railroads forge ahead.

Yesterday's pioneering railroader fought Indian battles, deserts, mountain floods, and blizzards. Today's pioneers carry on civilization's battle in hundreds of research laboratories. Less colorful and unsung, but heroes none the less, are the scientists who conquer unexplored fields of metallurgy, electricity, chemistry, and the many other branches of engineering having to do with railroads.

Ever-changing conditions of business and social life in this country make new demands upon the transportation world daily. Railroads long have occupied themselves with the job of keeping safe and dependable service abreast of the forward-moving tide. This work of American rail systems is well illustrated by the revolutionary improvements of freight service during the past five years.

Today, massive freight trains move on yesterday's passenger schedules. Mile-a-minute rail transportation of the world's merchandise is today's possibility and tomorrow's commonplace. Other links in the intricate railroad world are speeded up in rhythm with the modern trains. Rail service is extended to the customer's very door, and special facilities are provided daily for handling the complex products of an intensified civilization.

Painstaking laboratory research has removed railroad progress from the realm of hazard and experimentation. Safety and dependability have always been watchwords in railroading, yet they are doubly important today as thousands of tons of goods are rushed from producer to consumer overnight. Designers of new locomotives, cars, and other equipment are specifying strength far in excess of that actually needed for the anticipated service; they are demanding and getting greater factors of safety.

Until about 1930, railroads directed much of their research effort toward greater safety and economy. Millions of dollars were spent on roadbed improvement and signal systems. While this program was designed to, and did, reduce operating costs, it has proved of great benefit in the new speeding-up process. Much track curvature and steep grades were eliminated or reduced. Signal systems were improved to a point where they operate safely and efficiently under our ultra-fast schedules of today.

WITH scientifically tested rails in place on improved roadbeds, the railroads were ready to step up the tempo of their service when the demand came. Shifting economic trends forced merchants to carry smaller stocks. This necessitated immediate replacement and extra fast service on re-orders. Overnight service came with the depression. Harassed business men needed and demanded constantly increasing types of service.

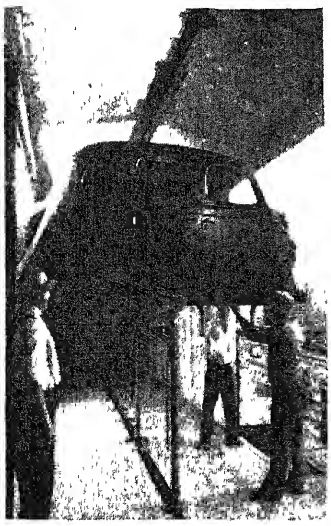
The store-door pickup and delivery system for less-than-carload shipments was pioneered by traffic experts who studied, tested, and perfected this new feature in railroading that has become an accepted service on all railroads.

In the Middle West, livestock is picked up in any quantity lots and carried to the central markets at carload rates, actual weight; it might be added that this saves the farmer the necessity of holding his livestock ready for market until he has accumulated a carload consignment.

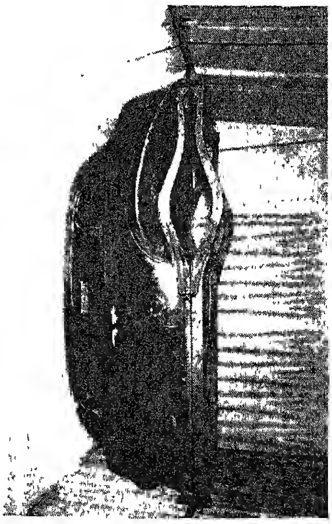
Railways have made household words of air-conditioning and streamlining. Present-day passenger trains are being widely and favorably discussed because of their many modern conveniences. Parallel improvements in freight service have been keeping step. But, because the passenger service offers intimate personal contact with the public, much more has been said of it than of our job of transporting the nation's foodstuffs, fuel, and daily necessities.

It has been said that the railway refrigerator car has done more to widen distribution of food than any other agent except the tin can. This is understandable, realizing that today seafoods, vegetables, meats, and fruits are delivered fresh daily to markets from coast to coast by American railways. Ten years ago, it required eight days for a fast freight train to carry fresh meat from Kansas City to Los Angeles. Today, the Santa Fe operates a freight service over that route, making delivery on the sixth morning. California fruits were handled to Chicago on a 154-hour schedule in 1925 while today that time has been shortened to 130 hours.

Between Chicago and Kansas City



More automobile bodies per car by new loading system. *Left:* Automobile body on stanchions ready to be turned into place. *Right:* Body turned and fastened for shipment



# TEMPO

there is a heavy traffic of goods from the Pacific Coast, Arizona vegetables, Texas livestock, Oklahoma petroleum, and Kansas wheat. Outbound from Chicago pours a vast stream of merchandise—automobiles, farm machinery, furniture, and all sorts of factory goods. Ten years ago the fastest freight service between these two cities required nearly 29 hours. Today, the usual operating time is around 20 hours. However, the Santa Fe sends a train over this route in 16 hours 45 minutes. I mention what we have done in these respects to typify what has been and is being done on many railroads today.

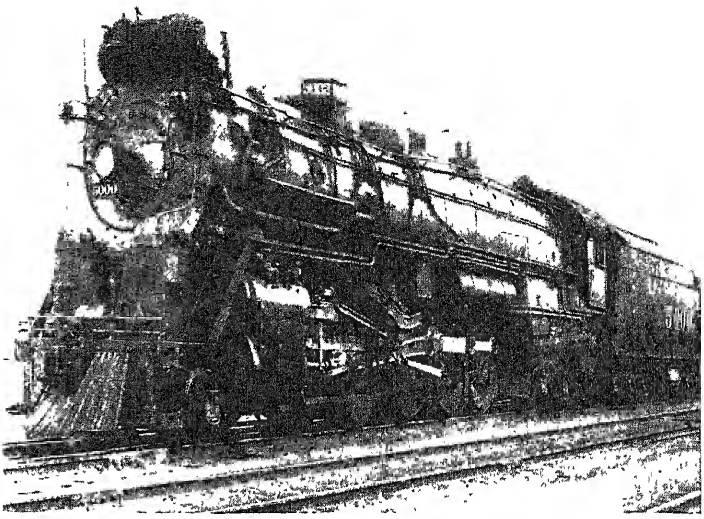
The schedule between Kansas City and Denver has been shortened by an entire day. The freight train run from Kansas City to Galveston has been cut from 78 to 48 hours. Between Kansas City and Amarillo, schedules have been shortened as much as 22 hours and 40 minutes. These schedules, however, do not tell the whole story of speeded-up freight service. Trains can and do operate ahead of their schedules in cases of emergency.

SINCE J. B. Sutherland, of Detroit, obtained the first patent on a refrigerator car in 1867, probably no other special-handling facility has been the subject of more experimentation than the railway refrigerator service. The Santa Fe reached California in 1885, and introduced refrigerator service to that country for the transportation of California fruits.

These early refrigerator cars, built along the lines of ordinary freight cars, except for ice bunkers holding 8000 pounds of cake ice and having about one inch or less of insulation, were mounted on the customary iron trucks. Today, these refrigerator cars are being built to carry 100,000 pounds. They have from 10,000 to 12,500-pound ice capacity, and they are insulated to a thickness of three inches and more. They are being mounted on cast steel trucks with both cast iron and steel wheels.

Special cars for the transportation of frozen fruit juices and other frozen products are insulated to a thickness of seven inches. Fresh meats are transported generally in cars equipped with brine tanks filled with ice and salt. These tanks are capable of reducing car temperatures to the freezing point.

The greater part of our perishable traffic originates in California or Arizona, and is handled for an average distance of 2500 miles. Standard refrigeration service is maintained along the system so that cars can be re-iced each 24 hours. However, in recent years, shippers have been pre-cooling their produce and icing it heavily in order to reach the markets with but one stop for re-icing. At the present time, 90 percent of the citrus fruit is marketed under these modified forms of refrigeration.



One of the largest locomotives recently built by the Santa Fe, a 2-10-4 type weighing 440 tons. Its tractive force is 93,000 pounds, its fuel capacity being 27 tons

Experiments are being made in the use of dry ice for refrigeration purposes.

Prior to 1930, development of freight motive power was aimed at increased capacity and economy rather than speed. Thirty-five years ago the well-known 1000 class Santa Fe type engines used compound cylinders and intricate driving mechanisms. This type of engine had a tractive force of 38,150 pounds and pulled 1200-ton trains at 30 miles per hour.

For the next 30 years, locomotive development simplified working parts, increased steam pressure from 180 pounds to 300 pounds, and produced the superheater which today delivers steam at a temperature of 720 degrees.

With old-fashioned lubricants, poorly treated water, and an excess of working parts, locomotives formerly ran from 150 to 180 miles and then were detained for two or three days in the roundhouse. Oil company laboratories have developed oils that will not break down under great heat; and chemists have given us modern treatment for foreign matter in water so that, instead of forming scale, this matter settles as sludge and can be blown off in the modern foam meter operation.

Incidentally, these foam meters have contributed no small item to the speeding up of trains. It was formerly necessary to wash scale and sludge from engine boilers after each trip. With meters in operation, engines sometimes run for 30 days without this cleaning.

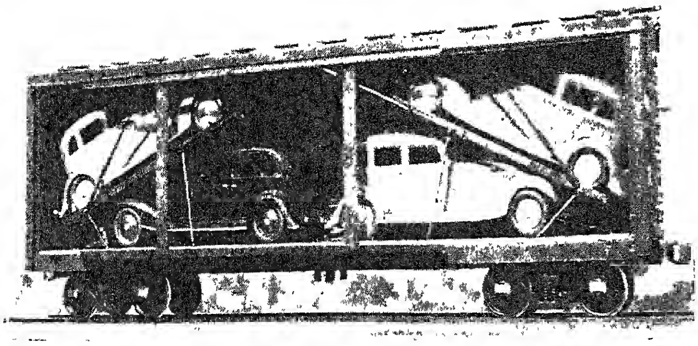
The meter operates from two electrodes of varying height protruding into the top of the boiler. As the water level rises due to foam in the boiler, contact is made with the electrodes, thus closing an electric circuit which, in turn, notifies the engineman that all is not well in the boiler, and opens a blow-off valve releasing the surplus water. As this water is blown off with some 200 to 300 pounds of steam pressure, it carries away the accumulation of sludge or other foreign matter which caused the foaming.

THE Santa Fe now is building new 5001-class, Santa Fe type locomotives that have a tractive force of 93,000 pounds. They have 74-inch driving wheels, are capable of pulling a 6000-ton train at 65 miles an hour, and weigh more than a half million pounds—538,000 pounds to be exact.

These engines can travel 100 miles between stops for fuel or water. They are designed to run 150,000 miles between trips to the repair shop. They are the conventional 2-10-4 type of engine that the road has used over a long period.

Terminal operations are keeping pace with other improvements over the wide range of railway operations. Diesel switching engines are replacing the steam switcher. These more compact power units can run for 24 hours a day and need not be laid up for cleaning and servicing to the extent necessary for steam engines.

Close co-ordination between the various railroads is much in evidence around the terminals. Ready interchange of cars and equipment from one line to another speeds steadily flowing traffic of the nation. Railroads are studying consolidation of terminal facilities where there is a possibility of effecting operating economies and at the same time ex-



The newest, most economical system for loading completed automobiles for shipment. The racks permit utilization of space hitherto a loss to shippers

peditiug the steady movement of traffic.

In addition to reaching out to the merchant's place of business with store-door delivery, railroads are handling storage and marketing facilities at the metropolitan centers. In Chicago, the Santa Fe owns jointly with the Illinois Central a produce terminal that covers approximately 100 acres.

Many railroads have constructed grain elevators. This permits cars to be unloaded promptly upon their arrival at the terminal rather than serving as temporary storage for grain. This is an important factor during the rush of the harvest season when delays are costly to grain growers. At the Santa Fe's Kansas City elevator, more than 30 cars of grain can be emptied per hour. A large unloading rack picks up cars bodily, dumps out the grain, and wheels the cars back to a switch track where they can be shunted into a train returning to the wheat fields.

Within recent months, railroad car engineers enabled a major motor car builder to save both money and time on automobiles shipped from the factory to Pacific Coast assembly plants. Ten car bodies had been the maximum load the maker had been able to ship. Much dunnage—crating and blocking—had been required. Loading and unloading was a long tedious job, and claims for cargo damages were frequent.

Freight-car engineers went to the factory and studied the loading system. Returning to the railway shops, they equipped a car with steel tracks at bottom and top. A stanchion was designed to up-end the automobile bodies so they could be bolted to the tracks. Using this system, 18 bodies now can be loaded where only 10 were carried before. The number of men required for the loading job was reduced, and the dunnage has been entirely eliminated. The car bodies now can be shipped finished, upholstered, and fitted with their instruments. They arrive at assembly plants just as they left the factory, without damage.

THERE has been developed a technique for loading car frames in gondolas. Such gondolas are fitted with racks and braces so that factory cranes drop the frames into place, eliminating hand shifting. These special cars are being provided in numbers to handle this rapidly developing class of business.

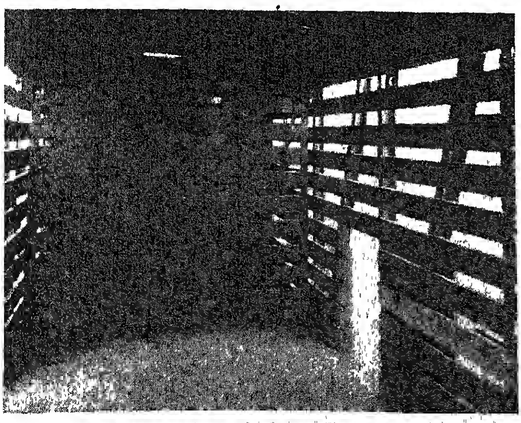
Many dry commodities and foodstuffs now are being transported in tank cars. These cars are of special design and equipment. They are closed to air and moisture while in transit. Expense of packaging and hand loading these products is eliminated since the "dry-flow" cars are filled and emptied by conveyors. Similar cars have been developed for handling cement, Fuller's earth, and other powdered clay products. Until recently these products were sacked and shipped in box cars.

Another development is a "closed hopper" car that can be loaded and unloaded pneumatically, eliminating damage and spillage, and saving time as well as handling expense. Powdered products are fed by gravity into air lines that force them up into storage bins several stories above the car track.

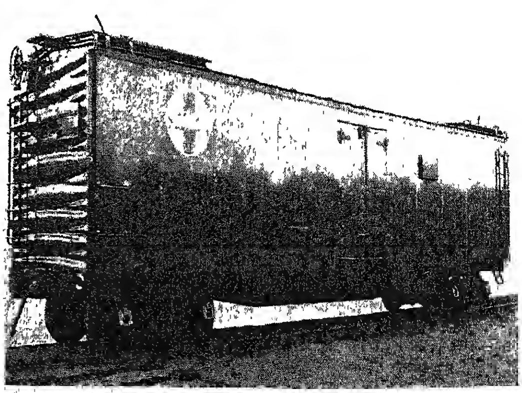
Endless examples of this type of service could be enumerated, but probably the most important factor in freight transportation remains the standard box car. This vehicle has been undergoing a constant evolution. Wooden box cars built for capacity loads of 40,000 to 60,000 pounds are rapidly disappearing from the rails of this country. Old fashioned brakes, light couplers, bolt-studded iron trucks and other items have been dropped from modern car building. New cars with steel underframes, steel ends, and steel sides can carry up to 100,000 pounds. They are equipped with better springs—snubber springs to reduce jolting—and some have an underframe which tends to make the car body "float." Steel roofs, riveted tightly to the walls, make the new car interior almost water- and dust-proof.

Unwieldy car doors that could be opened and closed only by main strength and strong language have given way to large close-fitting doors that move on roller bearings and that have special opening devices built in the fastening mechanism. Many other instances could be cited to show how freight service and equipment are keeping up to date. Everywhere along the railroad lines, new ideas are being tested and tried. As soon as they show merit in the saving of time, increase safety, or make for dependability, they are placed in service.

Today, research workers with pioneering urge are exploring new regions in scientific thought. Out of this exploration will come discoveries that will make the railway train of tomorrow even more attractive than it is today.



This car, with partition to be fastened at any point, makes



A rebuilt refrigerator car with a modern, steel superstruc-

# RADIUM—

# NATURE'S ODDEST CHILD

## Strange Experiments . . . Only One Chemist Survived . . . A Little Mistake that Cost $35,000, an Explosion, and a Sneeze that Cost $13,500

By JOHN A. MALONEY
The Museum of Science and Industry, Chicago

*(In Four Parts—Part Two)*

THE preciousness of the element radium is due in large part to the difficulties of extracting it from the parent ore (uranium) with which it is invariably associated. The wearisome labors of the Curies were not extraordinary when we consider that modern chemistry has made but slight progress in refining radium since the Curies pointed the way. Radium does not occur in great veins like coal or iron. but is found with uranium in what the chemist calls a state of equilibrium. This means that there is always a maximum amount of radium in proportion to the amount of uranium in which it is found. Contrary to popular belief, radium is found widely distributed throughout the lithosphere, or crust, of the earth, and there is good reason to believe that it occurs also abundantly within the interior of the earth.

Thus far, radium has been found in the earth associated with uranium itself or other ores containing uranium. Among these the most important is pitchblende, which is a blackish uranium oxide containing other metals in negligible quantities as impurities. Pitchblende deposits occur in Cornwall, England; in Jachymov (formerly called St. Joachimstaal) in Czechoslovakia; in the Belgian Congo; and in the Great Bear Lake region of Canada. Next comes carnotite, which occurs as a binder between the sands and has been found in Utah and Colorado. Carnotite bears the chemical name of potassium uranyl vanadate and it has played an important part in the history of radium in the United States. Autunite, a calcium uranium phosphate, occurs in Portugal and Australia, and has also been a source of radium production although not a very economical one.

It is impossible to predict how many more rich deposits of radium will be discovered, even in the very near future. In an age that is as highly mechanized as ours, it is difficult to conceive that any section of the globe has been left with stones unturned, but there are many. The machine age has tended to centralize population, and even the explorers seem to prefer spectacular trips to the polar regions to treks through the uncharted wildernesses that lie nearer home.

In addition to the original and crude method of detecting radium with a sensitized photographic plate, its presence within an ore can easily be detected by either of two methods—the electroscope and the scintilloscope (or spinthariscope). The electroscope usually consists of a metal chamber, in which is a

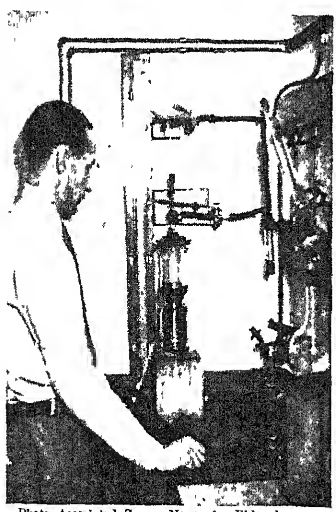


Photo Associated Screen News, for Eldorado Gold Mines, Canada

**A laboratory worker transferring radium emanation to a cylinder for measurement by the electroscope**

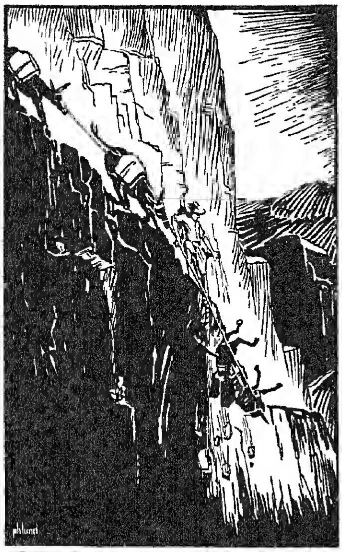
piece of metal suspended from an amber or sulfur insulator. Attached to the upper end of this strip is a piece of gold leaf. Ordinary electric charges will cause the gold leaf to fly away from the metal strip, and after the electricity ceases, the electroscope discharges and the gold leaf slowly returns to its original position. Bring a piece of radium-bearing ore near the electroscope and the rate of discharge is accelerated. Early electroscopes were not only crudely made but extremely delicate; modern instruments, however, are well adapted to the prospector's kit of tools. The scintilloscope consists of a closed brass cylinder with a lens at one end and coated on the interior of the other end with zinc sulfide. A radium bearing mineral brought close to the cylinder produces scintillations in the zinc sulfide that can be plainly seen within a few minutes—as soon as the eye has become accustomed to darkness. The result produced is most striking and can best be described as comparable with sitting on a vantage point far out in the Milky Way and gazing on a parade of brilliant planets and comets as they whirl by in a mad, dazzling, fascinating, and disordered array. It is as if the lecturer in a planetarium lost control of his "deus ex machina," allowing the starry firmament to run wild. It is a cosmic madness that cannot fail to entrance.

ALL of the radio-active metals affect a photographic plate by causing it to appear "light-struck," and that method of detecting radium has only rarely been used. It is not an infallible test because other radio-active materials, such as thorium, also transmit invisible rays to the plate.

But perhaps a more pleasant way to learn more about the methods of treating radio-active ore to obtain radium than an erudite discussion in chemical terms would be to follow some of the pioneers who came after the Curies; to share with them some of their experiences and, by thus projecting ourselves back into their ranks, really to appreciate the nature of this fascinating stuff called radium.

With the scenes shifted, then, from the shack of the Curies in Paris to Colorado, and the hands of time moved forward to 1920, we watch a burro train that moves like a lethargic side-winder rattlesnake over the narrow mountain passes. Joseph M. Flannery, President of the Standard Chemical Company, of Pittsburgh, has already explained in great detail the object of their quest to this crew of 300 men, who sit taut in

their saddles, eyes roving under perspiring brows over a horizon that dances in a maddening mirage, without even vestiges of vegetation to absorb some of the terrific heat. They all knew that they were going into that hot, arid country to pry loose as many tons of carnotite ore as the burros could carry back to the concentration mill 18 miles from the sand deposits—18 awful miles



Drawing by Percy Hale Lund

**"The warning came too late. Thirty-two animals were hurled to an instantaneous death at the base of the cliff. The dead burros were relieved of their precious burden and most of the ore was recovered"**

of waste that seared the souls of man and beast alike.

Throughout these stifling days these 300 men gnawed into the dust and loaded 300 pounds of it on the back of each burro. Then the train started back for the mill. The head driver decided that the burros must be roped together to keep them and their precious burdens from tumbling headlong into the gullies that were a half mile deep in some places. And roped they were.

What was the reason for all of this activity? The Austrian government had declared an embargo on pitchblende ore and, if the United States was to have its own supply of radium, these carnotite deposits must be tapped. No other region had given any evidence of containing radio-active material in paying quantities. And so we find the burro train moving back to the mill with 50,000 dollars' worth of ore upon their weary backs. All went well for the first few miles. Nearing a particularly steep cliff, the driver yelled a warning to the men to guide the burros with care—but the warning came too late. Thirty-two animals were hurled to an instantaneous death at the base of the cliff. Days and weeks went by as the dead burros were relieved of their precious burden and others brought up to transport it to the concentration mill. Most of the ore was recovered.

This procession kept up until 500 tons of carnotite had been dumped into the open maw of the concentration mill, where it was hand high-graded until but 100 tons remained. Then it was shipped in bags to the railroad depot at Placerville, and thence to Canonsburg, Pennsylvania, under special guard. At Canonsburg another crew of men awaited the arrival of the shipment and prepared the great tanks and tubs that would again begin the process of reducing.

It must be noted here, that, although the men engaged in this, the first attempt to produce radium in this country, were chemical engineers of the first order, they were in about the same predicament as were Pierre and Marie Curie in their shed. They were very unfamiliar with the substance they were refining and even less with the radium for which they were searching. It is not to be wondered at, then, that they went through some experiences which were almost as heartbreaking, and certainly more costly, than those through which the two pioneers had gone in France.

FOR experimentation and use, a gram of radium—one thirty-second of an ounce—is divided into 1000 parts, each called a milligram; these, in turn, are again divided into 1000 parts, each called a microgram. A unit of gas which emanates from a milligram is called a millicurie and 1/2700 part of this gas unit is called a Mache unit. Seldom does even a Mache unit go astray in the laboratory. To demonstrate the activity of even a Mache unit, the chief chemist of the Standard Chemical Company one day placed a Mache unit in one of six pills and asked six laboratory assistants to swallow them during his absence. Twenty-four hours later he was able, by taking a drop of blood from the ear of each man, to identify the consumer of the Mache unit!

The length of life of radium is determined in a peculiar way. Suppose, for example, that a given pound of radium could be watched during its entire lifetime. After 1690 years had passed, it would have given up half of its energy. At the end of another 1690 years the remainder would have given up half of its energy. At the end of the third 1690 the remainder would have released half of its energy. If mathematics is your forte, you are welcome to continue until you can write *Q.E.D.* after the final ray leaves the last atom of radium and mere lead alone remains.

Strange experiments were tried in Canonsburg with this new plaything. In the course of the work it was found that willemite, an ore of zinc, glowed with a cold light under the influence of radium emanations. Ten men were placed chest to back, the first in line holding a piece of willemite. One hundred milligrams of radium were held behind the last man's back and still the willemite glowed.

Water was found to have that peculiar kinship, which the chemists of those days called "chemical affinity," for the emanations of radium. After drinking water which had been treated with a sufficient quantity of radon gas, these pioneers found that a metallic object in the waistcoat pocket could be photographed, using the rays from the water in the subject's stomach as a light-source. Mr. Luther S. Gable, the sole survivor of six chemists who met their death from radium in those days, and who now resides in Brookfield, Illinois, still retains the photograph thus taken of his own watch as a grim memento of the fate which he escaped. A strange and dangerous X-ray process, that! Water thus charged loses half of its energy in two and seven-tenths days.

Radium history in the New World was repeating itself, and misfortune seemed to follow misfortune with an uncanny persistence. After the burro in-

**Rows upon rows of crucibles in the crystallizing department of the Standard Chemical Company's plant at Pittsburgh. At left is Dr. Krapf who died from radium**

cident and the safe delivery of the ore at Canonsburg came days of boiling and testing in huge, covered vats. Again it was the old game of "the needle in the haystack." Somewhere in that great array of seething crucibles was radium, perhaps a part of a gram, perhaps a gram, but it was radium! Just where it was, only this tedious process of refining and cooking would tell. One day a test of the tanks indicated that the radio-active material was confined to one tank. Orders came through from the chief chemist to drain off the other tanks and thus make room for more ore. The workman who turned the

valves which allowed the useless ore to run down a drain and into the river must have been quite perturbed by the responsibility of his position, or else very absent-minded, for he proceeded to valve off the wrong tank and at least 35,000 dollars worth of radium-bearing ore (and perhaps more) slid merrily down the drain pipe and into the river. There was no chance of recovery here. It was gone and the next day so was the workman.

The first illuminated dials for watches and gages were made here during this course of experiments. The entire dial, with the exception of the numerals, was made iridescent. The cost of such treatment was prohibitive and a purchaser would have run the risk of being burned unless he wore a lead shield for protection. And so another "crazy notion" was shelved, until the Ingersoll Watch Company put its illuminated watch on the market with a dial whose numerals were treated at first with radium but later with meso-thorium, a cheaper substitute of the radio-active family.

NATURE was lavish in her endowment of the element radium. Three kinds of emanations come from it; first, the alpha particle which becomes helium gas; second, the beta particle, which is the electron, or negative charge of electricity; and third, the gamma ray which is similar to the X ray. The metal tungsten had been made to give off an alpha particle and this fact led to some speculation on the part of radio-chemists. Tungsten is 22 points lower in the periodic chart of atomic weights than lead, and so it seemed that lead might be giving off alpha particles, but so slowly that they had not been detected. If so, lead was disintegrating, they argued. Disintegrating into what? Into the metal thallium and then into mercury and finally into gold! Here again, is the age-old dream of the alchemist cropping up—the transmutation of base metals into gold. But chemistry has passed that stage of speculation. Chemists today are not worried much about this dream. To them lead is a precious metal in this age of electricity—far more precious than gold in some respects. The machine age has been on a lead standard for many years but the economist has not found it out yet.

One of the research chemists at the Standard plant who had been analyzing the ore in a test tube announced that he had retrieved traces of radium-bearing salts by watering the radium-barium-sulfide, and soda metal. If it worked in a test tube, he reasoned, it might also work in one of the great conical tanks. All agreed that it should be tried. Perhaps it would prove to be a short cut that would eliminate some of the time lag that existed in the refining process. And so water was dumped into one of the great tanks and the group drew back to await the results. The results came all too quickly. A great cloud of smoke, brilliantly illuminated with radon gas, issued from the tank, and then the whole thing blew apart, burying its great weight in the dirt floor. Every inch of soil and every scrap of debris had to be dug up, pulverized and chemically treated before the precious ore could be recovered. Most of it was recovered.

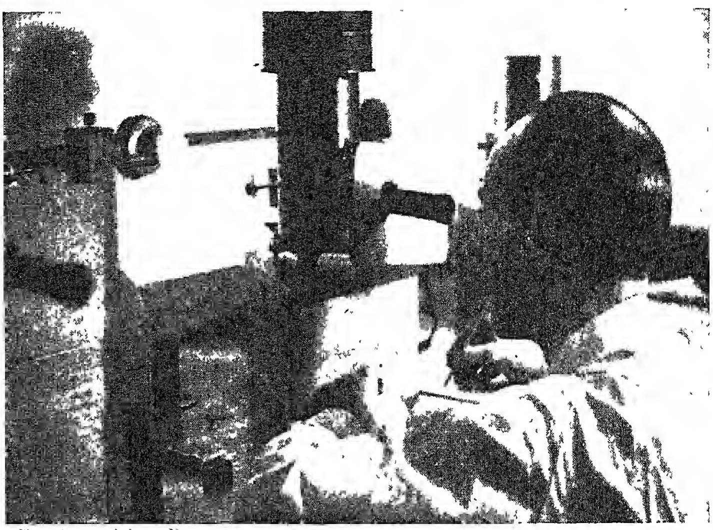


Photo Associated Screen News

**A physicist at the Ontario refinery of the Eldorado Gold Mines, Ltd., measuring with an electroscope liquor containing only .00001 milligram of radium**

Surely this was a train of costly accidents that was sufficient to try the patience of a Job. But Flannery was a man of great foresight and he kept his men at work and spent as much of his own time in the plant as did his most enthusiastic assistants. Radium was selling in the world market at this time for 125,000 dollars a gram, and Flannery knew that if the carnotite ore of Colorado could be made to produce enough radium every hospital in the United States could be supplied with it at a reasonable price. It seems, too, that the women of America were also demanding that Flannery produce radium enough for them to present to Madame Curie, who was coming to visit our shores. Madame Curie received her share of Flannery's radium, but the fates decreed otherwise for his radium clinics distributed throughout the United States. The demand for radium has always exceeded the supply, and doubtless always will, but in those days the needs of medical centers, universities and research laboratories whose researchers needed radium to help solve the atomic structure of matter, were large. Today, although radium is important in physical investigations, it has been supplanted, in the domain of the atom smashers, by high-speed particles shot from cyclotrons and giant static generators—the heavy artillery of physics today.

The day finally came when a minute amount of the elusive radium salts was cornered and placed with loving care in a watch crystal on a laboratory table. What a surprise for the boss, the men remarked to each other. Before the dust of the day's work had been completely swept away, a call was sent to Flannery to come to the laboratory at once. The staff waited with bated breath. In he came, and they pointed with justifiable pride to the watch crystal. Flannery leaned lovingly over it.

"How much is it worth?" he finally inquired.

"At the present market price", answered the chief chemist, "it is worth about 15,000 dollars."

"And it cost us . . ." Flannery had started orally to compute the cost when some of the dust that was being swept up entered his nostrils. "Ka—choo!" he finished, and blew the 15,000 dollars worth of radium salts into invisibility. The watch crystal was empty. The situation did not seem as humorous then as it does now.

Everyone in the room was made to disrobe; every nook and cranny was swept with fanatical zeal; the floor was scrubbed with hydrochloric acid; and the collections of clothing, debris and dust were burned. All but about ten percent of the radium was recovered from the ashes.

Radium took its awful toll in those days, too. Dr. Emil Krapf, Dr. Alvin Krammer, Paul F. Hague and Dr. Charles H. Viol all died within a few years of each other, and all of them were in their thirties. Flannery, himself, met a similar fate, toppling over dead as he crossed the living room floor in his home. Gable, the sole survivor of this group, believes that Flannery may have inhaled the 10 percent of radium salts which could not be found the day he sneezed it away.

*(To be continued)*

# PYRAMID TEMPLE

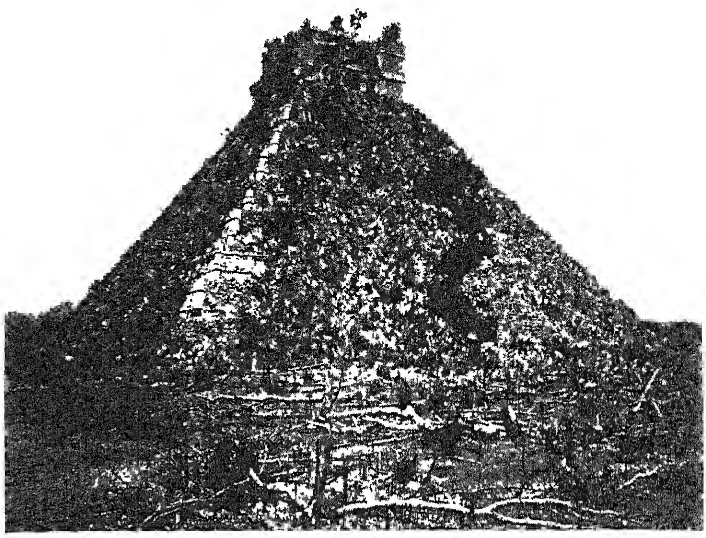
DURING the summer of 1936, archeologists of the Mexican Government, working at the Maya ruins of Chichen Itzá, Yucatan, made an extremely important discovery. They found that El Castillo, the most impressively dominant of the pyramid-temples of the famous site, embraces within itself an older pyramid-temple that has been completely concealed for centuries. When the chambers of this inner temple had been cleared of the rubble with which they had been filled, objects were revealed of the utmost value to the scientists who are trying to clear up the perplexities that have arisen respecting the Maya race, the greatest of all the pre-Columbian races of the New World.

El Castillo, built to honor Kukulcan, one of the members of the Maya pantheon of gods, stands near the center of a 45-acre terrace which is composed of rubble masonry raised a few meters above the level of the vast limestone plain which comprises almost the whole of the northern portion of the peninsula of Yucatan. Surrounding the pyramid lies a complicated agglomeration of temples, courts, arcades, colonnades, palaces, and mounds not yet excavated—an architectural complex so extensive, indeed, as to indicate that Chichen Itzá, when at the height of its development, must have truly presented an amazing spectacle.

The peak of this construction activity at Chichen Itzá was reached during what is known as the New Empire period of Maya history, a period which probably began soon after the middle of the 11th Century and which continued well into the last half of the 15th Century, almost to the time of the coming of Columbus. This period of three and a half centuries is often referred to as the period of the Maya renaissance, and it is indeed true that during this time Maya culture experienced a sharp revival which found its most fruitful expression in the design and construction of great buildings for religious and ceremonial purposes.

This awakening to exuberant architectural activity appears to have been due, in part at least, to the influx of an alien people from the west. There is uncertainty as to just who these people were, but there are grounds for believing that they belonged to the great Nahuan linguistic group of Mexico. At all events they profoundly affected the art, the architecture, and the religious and ceremonial life of Chichen Itzá, Mayapan, and Uxmal, the three city-states of Yucatan that, during this period of Maya history, formed the political confederacy known as the League of Mayapan.

The invaders from the west brought with them, for example, worship of Kukulcan, the feathered-serpent god,



**Before its restoration by the Mexican Government the old Maya pyramid was in a sadly tumbled-down outside condition. Trees grew over its damaged faces**

## The Most Spectacular Discovery of Archeological Specimens in Original Position Ever Made in the New World . . . The Jaguar Throne of Chichen Itzá

who was represented by a rattlesnake having a body whose scales were replaced by the feathers of the sacred quetzal bird and from whose mouth a human head frequently protruded. Everywhere in Chichen Itzá among the buildings of the New Empire period, representations of this all-powerful divinity of the earth and sky are to be found. In columns, cornices, façades, balustrades, murals, bas-reliefs, the Maya artists and sculptors employed the feathered serpent as an ornamental *motif* with unrestrained prodigality.

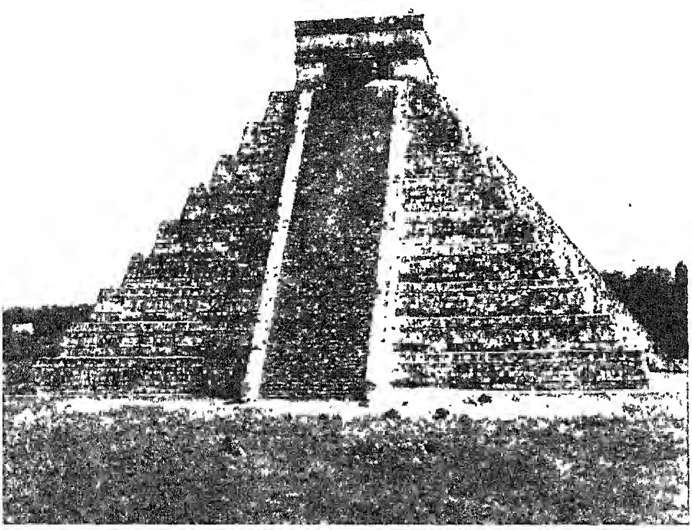
So, too, the immigrants from the west seem to have been responsible for the marked increase that took place in the performing of human sacrifices. Indeed, it is thought by some that they are rightly to be charged with having introduced the religious ceremonies that were associated with El Castillo and the sacred well near-by—ceremonies which culminated in casting the most beautiful of the Maya maidens into the well in a supreme effort to appease the rain-god who was thought to have his abode in the depths below.

Such was the period of the New Empire among the Maya of Yucatan—a period during which the culture of this extraordinary race came into its final flowering. It was early in the period and in response to the renovating and rejuvenating tide of new life that flowed into Chichen Itzá, that El Castillo, the pyramid-temple of the great god Kukulcan, was erected. Abandoned soon after the coming of the Spaniards, Chichen Itzá and its magnificent structures quickly fell prey to the inexorable advance of the jungle. Indeed, the whole of this great Middle American civilization dropped out of human consciousness, became lost to human view.

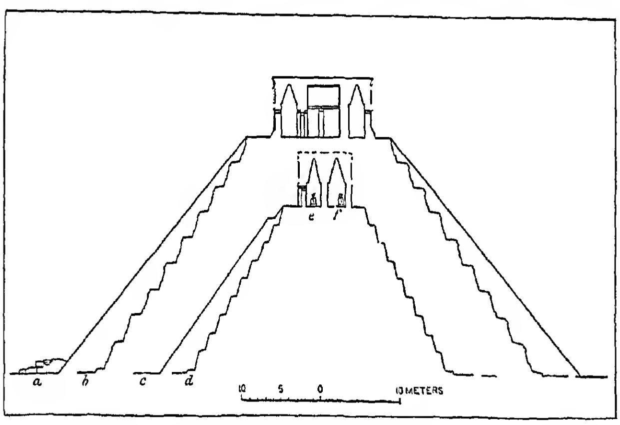
In 1925 a Department of Monuments within the Ministry of Public Education was established by the Mexican Government and responsibility for supervision of the ruins in Chichen Itzá vested in one of its bureaus, that of Pre-Hispanic Monuments. Of this bureau, Sr. Ignacio Marquina has been the head for several years. With the creation of the Department of Monuments, steps were taken to protect the ruins and, in the case of El Castillo, to restore the missing stones to their original positions.

In planning and executing this work of repair and restoration distinguished engineers, architects, and archeologists were called upon for assistance.

# OF KUKULCAN



The great pyramid, 79 feet high and 197 feet wide, as now restored, showing the northern face. Stone stairways rise to the summit on each of the four faces




A north-to-south cross-section of the pyramid showing: *a*, outer stairway; *b*, outer terraced face; *c*, inner stairway; *d*, inner terraced face; *e*, vestibule of concealed temple; *f*, sanctuary of concealed temple, with the jaguar throne

The restoration, so far as it could be carried with assurance that the original design was being faithfully followed, was completed in 1927. To give an idea of the state of the pyramid-temple before repair, one of its sides, the south side, has been left as it was. Pictures made in the last century show how disastrous had been the effect wrought by the forces of nature and by the inhabitants of neighboring villages, as well, who had removed much of the original facing for use in their own constructions. Comparison of the picture of the restored structure with the one at the head of this article will give some idea of the magnitude of the task undertaken by the Bureau of Pre-Hispanic Monuments and also how well that task was performed by this Mexican bureau.

Meanwhile, the Mexican Government entered into contract with the Carnegie Institution of Washington, effective as of January 1, 1924, whereby the Institution was permitted to conduct archeological studies at the ruins of Chichen Itzá. In 1925 the Institution staff began excavating a tree-covered mound of debris near El Castillo. As fallen elements were identified and restored to original positions, this structure, called the Temple of the Warriors, grew into one of the finest examples of New Empire construction so far found in the entire Maya area.

It was a year later, in 1926, that Earl Morris, in charge of the work at the temple, made a discovery about the way in which the pyramidal foundation had been constructed that suggested a new field of investigation which archeologists have been quick to follow up. He had almost completed work on this structure when a sculptured column block projecting from a corner of the supporting pyramid suggested that some exploratory excavation of the pyramid itself should be undertaken. As a result of the investigation which he made, it was found that chambers existed belonging to an earlier temple, and that they had been filled with rubble and had been incorporated, in their entirety, in the pyramidal base of the Warriors Temple.

Morris dug out the filling, shored up the walls with concrete piers to prevent collapse, and drove shafts to the surface for air and light and easy access. In the course of this work many features were revealed which have thrown important light upon the stage which Maya culture had reached when this early temple was erected.

Discovery that the pyramid builders of the Warriors Temple, instead of completely demolishing the older structure, had preserved a substantial portion of it by filling it up and covering it over, suggested that a similar practice might have been followed in the erection of other Maya pyramids, and this has proved to have been the case. Excavation of a pyramid-mound at Uaxactun, Guatemala, in 1928, by Carnegie Institution archeologists revealed that, while external appearances pointed only to a structure of rough rubble, actually a beautiful pyramid of uncut stone, faced with four stairways, each flanked by colossal masks of lime stucco, lay completely buried beneath the rubble covering. Again, during the past year, partial excavation of a mound near Guatemala City by Dr. A. V. Kidder, head of the archeological staff of the Institution, disclosed that it contains a series of no less than four superimposed pyramids and a like number of burial vaults, from the latter of which objects of rare archeological value are being taken.

So too, in 1936, archeologists of the Mexican Government, upon completing exploration of El Castillo, added another conspicuous example to the growing list of treasure-yielding pyramids, as we shall see.

Exploratory work on this great pyramid to determine what, if anything, lay concealed within it, was begun in 1930 under direction of Sr. Marquina. The first step taken was that of driving a tunnel at ground level straight in from a point at the center of the south face of the pyramid. Thirty feet within, the base of an earlier pyramid was encountered, whereupon the tunnel was turned to the left, or west, and driven along the base line of the hidden pyramid to reach the southwest corner. Turning the corner, the tunnel was continued northward along the western side of the inner pyramid to a point far enough

past the center to prove that no stairway existed on the west face of the inner structure.

Next, the attack was shifted to the north face of El Castillo and at a point at the base line just west of the stairway, selected to avoid damaging the stairway, a tunnel was run east until it was under the center of the stairway, then it was turned to the right and driven south toward the heart of the pyramid. Here, at a distance of about 30 feet, the base of the older pyramid was reached a second time, but, unlike their experience with the tunnel at the south face, the investigators encountered a stairway, apparently leading up the north face of the buried pyramid.

At the foot of the newly discovered stairway they came upon a rectangular limestone box, approximately 2½ feet long, two feet wide, and two feet deep. It was covered with a lid consisting of a single stone slab which had been fitted to the opening.

Outside the box lay the skeleton of a man. When the ponderous lid was raised, to the delight of the archeologists there were revealed: two turquoise mosaic plaques; three necklaces, one of coral, one of turquoise, and one of jade; seven heads of jade; five jade pendants, one of which was an exquisitely carved, iridescent piece representing the figure of Itzamná, the head of the Maya pantheon; a piece of jade with a fragment of cloth attached; about 2000 loose button-shaped beads of turquoise; and two unusually large sacrificial knife-blades of flint, four inches wide and more than a foot long.

Dr. Sylvanus G. Morley, of the Carnegie Institution staff, who examined the box and its contents soon after discovery, believes that it is to be regarded as a ceremonial deposit made upon the occasion of the commencement of work upon the new pyramid—a procedure suggesting the modern practice of laying corner stones and of depositing within them or under them boxes containing objects of probable interest to future antiquarians.

A year or so after discovery of the inner stairway and the box at its foot, Sr. Marquina and his colleagues began sinking test pits in the platform at the top of El Castillo to see whether the inner pyramid was surmounted by a temple structure. They soon found that such a structure existed; that it had been filled in instead of having been demolished; and that its top lay only about a meter below the floor of the outer temple. By means of tunnels run in different directions they learned that the temple surmounting the earlier pyramid contained two chambers, one directly behind the other, and that entrance was gained through a single doorway at the north side which, in turn, was reached by the stairway running up the north face of the inner pyramid of the two.

During the working season of 1935, the outer chamber of the older buried temple was cleared of its rubble filling. At the center of this chamber a stone statue was discovered which represented a recumbent human figure (the so-called Chac Mool figure) of which ten others have been recovered in Chichen Itzá. Unlike all the other statues of this type,

**The jaguar throne found in the inner chamber of the buried temple. It was carved from a single block of stone and is painted vivid red, except the spots on the legs and the eyes, which are represented by inlays of apple-green jade, and the teeth and fangs, which are hard white stone. A mosaic turquoise was found on the seat of the throne**

so far found, the ten toenails of this one, made of highly polished white bone, were still intact. Both its upper and lower teeth, made of the same material, were in position, as were its eyes which were also made of white bone. To represent the pupils of the eyes, circular pieces had been cut from the centers and replaced with a black material resembling pitch.

During July and August of 1936 the excavation of the inner chamber was pushed to completion and an amazing discovery made. The back wall of the chamber was found to have been studded at regular intervals with the heads of human femurs, presumably obtained from sacrificial victims. At the center of the chamber stood a box, made of squared limestone blocks, which was covered by two ponderous flat stone slabs.

Inside the box was a throne fashioned from a single block of stone, carved to represent the figure of a jaguar, and painted a vivid red. As the figure has been shielded within the pyramid all these centuries from the light, the color is probably almost as brilliant as when it was originally applied. The spots of the jaguar are represented by inlays of apple-green jade. The eyes also are made of jade, unusually large hemispherical pieces of excellent quality having been used for the purpose. The teeth and fangs appear to consist of hard white stone. The principal dimensions of the statue are: Greatest length, 33 inches; greatest width, measured through the shoulders, 12½ inches; greatest height, measured from the bottom of the base to the top of the head, 27 inches.

Resting upon the jaguar seat lay a mosaic turquoise plaque similar to the two found in the box at the foot of the stairway. On top of the plaque reposed a shell necklace, and a jade pendant, carved to represent a human face. Dr. Morley is of the opinion that this central object of the inner chamber may properly be identified as a jaguar throne. He points out, in support of this opinion, that double-headed jaguar thrones have been found in the ruins of the New Empire city of Uxmal; and that representations of it are to be found in the paintings on the walls of the inner temple chambers of the Temple of the Warriors and at two other sites.

It is not improbable that figures of the jaguar, the eagle, and other animals, as well, were employed by the warrior cults or societies of Yucatan very much as insignias are used by the various orders of modern times to identify particular groups. Neither is it improbable that the older temple buried within the pyramidal base of El Castillo was erected by the jaguar cult of warriors and used by them in ceremonial practices.

Although the contents of the box found at the foot of the inner stairway of El Castillo have been taken to the Museum of Archeology and History at Merida, the capital of the State of Yucatan, for safe-keeping, very wisely the Mexican authorities have decided not to remove the reclining human figure and the jaguar throne, with its turquoise mosaic plaque, from the chambers of the inner temple. Instead, they have covered them with protective varnish, glassed in the jaguar throne, and installed artificial lights.

It is therefore now possible for visitors to enter the tunnel at the base of the north face of El Castillo, to follow through to the foot of the inner stairway where the ceremonial box reposes, to ascend to the summit of the buried pyramid and thence, through the portal of the hidden temple, to enter its age-old throne room, and there witness, in imagination, the barbaric scenes that once took place in this sacred inclosure and to view, in actuality, what Dr. Morley has characterized as the most spectacular discovery of archeological specimens in original position ever made in the New World.

# THE ENDOCRINE BRAIN

## Hormones from the Ductless Glands . . . Problem of the Pituitary . . . Giants and Dwarfs . . . Thyroid Hormone for Stout People...Made a Rooster Broody

By DARWIN VEXLER

A SHORT time ago a demonstration of some new experiments with the ductless glands was given at one of the large eastern universities. At a signal from the lecturer one of the experimental animals was brought into the auditorium, as lively and happy an example of dogdom as one might wish to see. He jumped affectionately upon the attendant who brought him in, and barked away to the immense amusement of the scientists present. Yet that animal was minus a part of one kidney and two ductless glands. The only thing that kept him alive was a daily injection of hormone, an artificially prepared substitute for the products of the glands that had been removed from him. In that dog had been conquered two conditions that, until a few years ago, meant mysterious and certain death when they occured in humans.

The hormones are secretions produced by certain glands in the body and poured directly into the blood. In their action the glands are very close kin to the much less puzzling ones which have ducts, such as those which produce tears and those which form saliva. But, instead of sending their products to some very definite part, by means of a little tube which can be seen, they empty directly into the blood. The substances they discharge do not themselves perform visible actions, but they cause some bodily function to be performed—much as pressing the trigger of a rifle causes it to fire. These secretions are the body's messengers traveling along the roads of the body, the blood vessels—indeed it is from the Creek word for messenger that they have been christened hormones. The glands that produce them have been named the ductless glands or endocrines. Of them all, perhaps the most interesting and the most important is the pituitary.

Though it was discovered some 300 years ago, little attention was paid to the pituitary till 1886, when a French physician, Pierre Marie, discovered that the disease of acromegaly was due to it —and then himself died of acromegaly! A few years later two Englishmen found that control of the blood pressure was dependent on the pituitary, and called it the "brain of the endocrines." Later work has shown that they named more

A case of acromegaly, shown chiefly by the changes in the jaw. Some cases are considerably worse than this

wisely then they knew, and that there is scarcely an action performed by the body which is not influenced by this organ.

The pituitary arises in the embryo animal as two little pouches, one forming in the floor of the brain near the forward end, the other from the roof of the future mouth of the animal. The little out-pocketing in the future mouth region becomes detached, forming a small sphere, and moves upward till it joins the part which has arisen from the brain. In the adult the pituitary, a small body about the size of a hazel-nut, is found to be made of three parts—a nervous part, which has come from the brain, and intermediate and anterior parts, both of which originated as part of the embryonic mouth region. The gland lies in a bony case at the base of the skull, and is richly supplied with blood vessels to receive its secretions. Three different cell types have been distinguished in the anterior part of the organ, but only one kind has been found by microscopists in the intermediate part. Six hormones are known to be produced by the anterior part. Of them the gonadotropic or sex stimulating hormone has been shown to come from one of the three types of cells, a kind which will stain in basic dyes, and the growth hormone from another, a variety which stains in acid dyes. Apparently also both of these kinds of cells can change into the third variety. Only one secretion has been isolated from the intermediate part.

Like most scientific problems, that of the pituitary is basically quite simple. We know that something is produced by it, and wish to know what that something does and what it is, so that we can make it ourselves and find out just how it acts. It is partly curiosity and partly immediate usefulness that dictate the study, and there is always the knowledge that the mere curiosity may lead into finding something of great immediate importance. The method of going about the work is almost self-evident: either remove from the animal all the substance which is to be investigated, and see what he does without it, or add more of it to a normal individual and see what that does. Then take it all away, and give this animal the artificially prepared substance. In actual practice, of course, this becomes complicated. There is the question of devising a method of completely removing the substance from the animal. That, in the case of the pituitary, involves an operation for the removal of the gland, which lies close to the brain in a well-protected bony box. The chemist is drawn into the work because his is the job of preparing the extracts and isolating the pure hormones. Different kinds of specialists have their fields in following the effects upon various systems of organs, the heart, blood-vessels, sex glands, and others.

The investigation of the intermediate part of the pituitary, simpler and of less general interest than the anterior part, illustrates pretty well how the work is done. A great deal of the research has

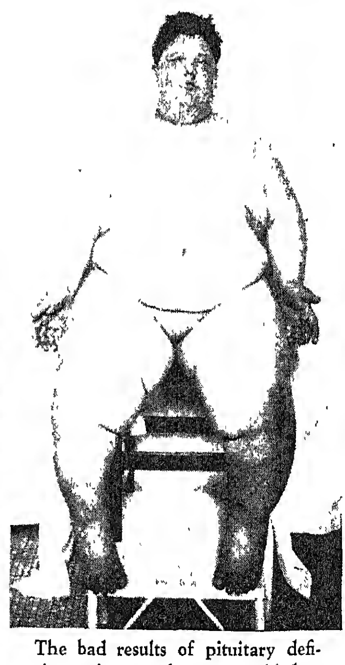
been done on lower animals—frogs, other amphibians, fish. This is due partly to the difficulty of working with mammals—removal of the pituitary in one may take as long as four hours and is dangerous—and partly to the remarkable effects of this part of the gland on amphibia. The operation is done under a low-power microscope, upon the tadpole, for example, when it is about one sixth of an inch long. At this time the pituitary is still being formed, and the brain part has not yet been joined to the mouth part. An interesting sidelight is the fact that cutting out the mouth part has been found to inhibit the formation of the brain part.

THE frog's skin carries two kinds of pigment, black and silver, arranged in a series of layers. When the pituitary is removed, the frog turns from a nondescript black to a beautiful silvery color. Close study has shown that this is due to the black granules of pigment becoming fewer in number, and agglomerating into small compact blobs, while the silvery pigment becomes spread out into thin layers and can easily be seen. Transplanting some of the silvery skin to an animal which has not been operated upon causes it to become black, and the reverse experiment will also work. Extracts of the intermediate part of the pituitary cause the skin of an operated animal to turn black when injected. Dr. Zondek, an endocrinologist whose pregnancy test is well known to physicians, has obtained a very potent extract which he calls intermedin.

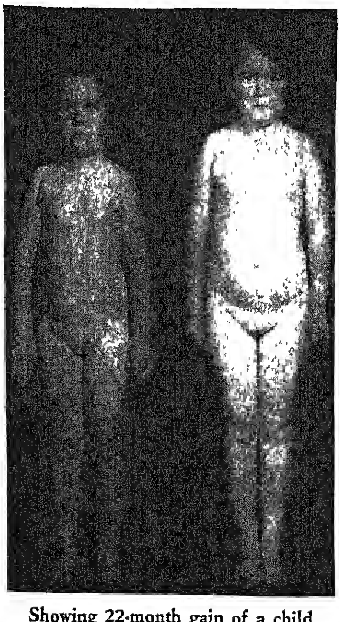
However, it is the secretions which come from the anterior part of the gland which most closely affect humans and are most interesting. Probably the best known of them all is the growth hormone. Dwarfs and giants are fairly common among humans, and the clinicians showed that these conditions were accompanied by abnormal pituitary glands. To investigate these conditions experimentally it became necessary to devise a method of operating on the pituitary of some mammal. Many scientists made attempts before Dr. Ascher of Berne University, Switzerland, performed the first successful operation on young dogs. There was complete absence of growth after the operation, and young animals never became sexually mature when the pituitary had been removed. Dr. P. Smith of Columbia University perfected the now most generally used experimental method. He used rats, which have the pituitary attached to the brain by a very thin stalk, making it possible to work quickly without injuring the brain. One hundred and five operations were performed in one set of experiments, and in each case the rat showed absolute failure of growth, not gaining a gram after the removal of the pituitary. They remained sexually infantile, and the sex glands degenerated. Yet, injection of an extract of the gland for one month caused the animals to become perfectly normal and to equal their unoperated brothers in size. Feeding the gland was without effect, the hormone being digested in the stomach. Also, by injection of pituitary extracts rich in growth hormone Dr. Evans has been able to produce giants in rats which in respect to size in this species of animal would be equivalent to humans 12 feet tall. Of course no human being ever attains such dimensions.

The human disease of acromegaly, discovered so long ago by Marie, has been found to be due to excessive production of the growth hormone. In adults the bones lose their ability to grow. Some parts of the skeleton can, however, continue to grow throughout life, the cartilages of the nose and chest, those between the vertebrae, the jaw, being among them. All these resume growth under the influence of the pituitary, stimulated to produce abnormal amounts of growth hormone by certain types of tumor. The victim becomes ape-like in appearance, with a tremendous chest, hunched posture due to the lengthening of the back-bone, long fingers and toes, and a prognathous jaw. The pituitary increases in size, presses on the brain, and causes headaches and blindness. The patient finally dies. An operation for the removal of the pituitary now brings relief.

One of the by-products of the investigation of acromegaly was the demonstration of the fact that heredity is a factor in the effects produced by the hormones. Bulldogs with large jaws could be made to grow even larger ones by giving them growth hormone, but this effect could not be produced in shepherd dogs. Dr. Evans injected the hormone into dachshunds. He was able to make the animals grow in weight, and could cause them to become so heavy that they could no longer walk, but the legs could not be made to grow. In man there is a kind of dwarf which has a normal body, but very short legs. It would be dangerous to attempt to bring this sort of dwarf to normal stature by injecting the extract, reasoning from the effects of the growth hormone on dogs, as this might make the individual all the more heavily torsoed without affecting the legs. This type of experiment has, however, been tried with a race of silver mice which is born with insufficient growth-hormone producing cells in its pituitary gland. These mice would correspond to the dwarf human who is



The bad results of pituitary deficiency in an eleven-year-old boy



Showing 22-month gain of a child of nine under a pituitary extract

Courtesy *Journal of the American Medical Association*

*Left:* Hairiness in a woman of 43. Related to endocrine dysfunction

well, but diminutively proportioned. The mice were made to grow to normal size.

Dr. Smith removed the pituitary from a tadpole and found that the thyroid gland did not develop. This was the experiment which led to the discovery of another pituitary hormone, the thyrotropic. The thyroid gland is another of the endocrines and is very important in determining the metabolism—the speed at which one lives.

The tragic result of pituitary deficiency in a woman aged only 27

Recently the thyroid hormone has been given to stout people. It causes them to use more energy, to live faster, and in the process they use up the fat they have accumulated. The same hormone has very marked effects upon the heart, speeding it up. In the frog it is necessary to the process of metamorphism from tadpole to frog. Smith's operated tadpoles would not change into frogs, though he had not directly touched the thyroid. In another experiment he removed the thyroid gland, leaving the pituitary, which immediately began to grow larger. Injection of pituitary extract caused the development of the thyroid in the first set of animals, but did not affect the second. Here was a substance produced by a ductless gland which acted on another ductless gland.

Similar experiments have been performed on mammals. When the pituitary was removed the heart rate and the basal metabolism—the amount of energy used when resting—fell. The thyroid degenerated and the animal could not mobilize its forces. Injection of

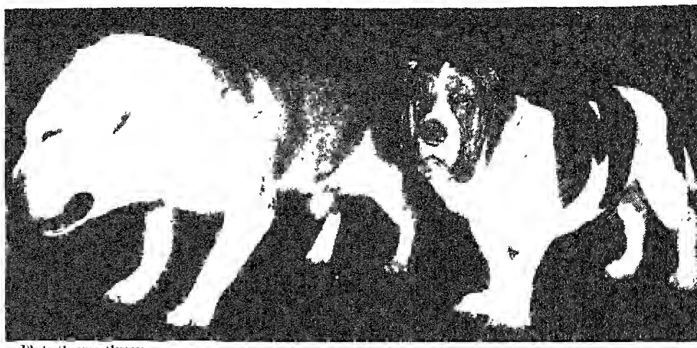


Photo Science Service

**Normally, the pituitary makes all parts of the body grow the right size in relation to each other. One of these dogs, from the same litter, is imbalanced**

pituitary extract containing the thyrotropic factor corrected all these symptoms. Too much of it caused the thyroid to grow to several times the normal size and the eyes to bulge, just as they do in certain types of goiter. The effect was that of giving enormous amounts of thyroid hormone. Very little has yet been done in applying these results to man. But there are diseases like cretinism, where dwarfism and idiocy are due to insufficient thyroid development, which promise fields for the use of them.

Another hormone having a similar effect in the control of another of the ductless glands has been found. This is the adrenotropic, which exerts its effect upon the adrenal glands, two small bodies lying near the kidneys. The absence of these is responsible for the fortunately rare Addison's disease. Here, too, there is a promising field for medical application.

The disease of acromegaly, due to excessive pituitary activity, is often accompanied by a variety of diabetes. Dr. Houssay of Buenos Aires finds still another substance from the anterior part of the pituitary which is antagonistic to insulin, the controller of the amount of sugar in the blood. The pancreas produces insulin. If enough is present in the blood, there is a normal amount of blood sugar. If it is not, then the sugar accumulates in the blood and diabetes results. Dr. Houssay removed the pancreas from toads, and they came down with diabetes. If he removed the pituitary as well, the animal was only precariously healthy, but the smallest amount of pituitary extract would cause diabetes. Starving for a day would cause convulsions because the blood sugar had dropped too low. These convulsions could be relieved by feeding sugar, just as in hospitals today an overdose of insulin is counteracted by feeding sugar. Houssay named the pituitary substance the diabetogenic hormone.

A fifth hormone has been designated the ketogenic, and when it is present in too great an amount it prevents animals from utilizing fats. Instead of burning them completely to carbon dioxide and water, the abnormal animal only partially consumes fat and produces the so-called ketone bodies. These are responsible for the characteristically aromatic odor of a diabetic's breath. Like the smoke of an improperly burning lamp, they indicate waste and a pathologic condition. Just how the ketogenic factor acts is still a mystery. In man the discovery of this and the diabetogenic hormone may yet cause a change in the method of dealing with some cases of diabetes.

A great deal of recent investigation has been concerned with two other hormones from the anterior part of the pituitary. One is the lactogenic, by the correct administration of which it was possible in one hospital recently to permit 25 of 29 mothers who submitted to the treatment to nurse their children normally, as they otherwise would have been unable to do. The same hormone caused a normally not broody variety of hen, and even in one case a rooster, to brood.

THE sixth is the gonadotropic, the hormone which controls the functioning of the sex glands. In one striking example rats which normally produce ten to twelve ova or eggs at each cycle of sexual activity, produced as high as 40 after treatment with the hormone. In mammals it has been discovered that there are really two hormones, one of which causes the eggs to descend from the female sex glands, the other of which causes formation of the "yellow-body," the corpus luteum, in the ovary. This produces still another hormone, lutein, which allows the fertilized egg to become attached and form an embryo, besides aiding in causing the secretion of milk and preventing the production of more eggs during pregnancy. Many attempts have been made to cure sterility and to alleviate periodic pains by the use of these extracts.

The entire science of the pituitary gland is one of the livest corners of present-day medical physiology. New and important discoveries are appearing in every issue of the scientific journals such as *Endocrinology*, and this new work is being closely watched by both the physicians and the manufacturers of pharmaceutical products.

# THE PERSISTENCE OF LIFE

By T. SWANN HARDING

LIFE frequently shows a strange power to resist destruction. Living things—bacteria, animals, and men—are much affected by their surroundings. Temperature and nutrition especially influence both the rate of living and the length of life of all organisms. Some organisms show almost incredible power to resist adverse conditions or to survive in the entire lack of food. On the other hand, some stories of the persistence of life under adverse conditions cannot be credited. Let us see whether we can separate truth from fallacy in a few accounts of instances where unusual persistence has been claimed.

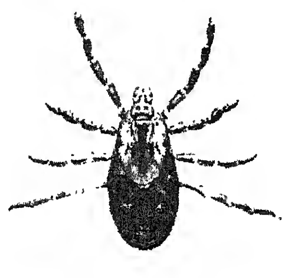
One of these recent reports which amazed laymen, but rendered biologists distinctly skeptical, came from P. Kapterev of the Soviet of Sciences. It concerned the thawing out in the laboratory of chunks of frozen subsoil from a region where it is supposed to have been frozen for thousands of years. We were told that spores, grasslike plants, and a number of small animals emerged in a fine state of survival.

Thus far, this report has not been contradicted. But the average biologist, when interviewed about it, usually shrugs his shoulders and looks unconvinced. We are reminded that, but a few months back, Dr. Ira B. Bartle of California reported the persistence of certain microscopic dots of life throughout a period of 249 years. He claimed to have resurrected colonies of soil bacteria that went into suspended animation two centuries and a half ago in the four-foot adobe walls of an Arizona mission house.

THEN there was the even more famous case of Charles B. Lipman, who reported finding living bacteria in stony meteorites from the heavens. This appeared to confirm the theory that life on earth got its start via life-seed from the celestial regions. Lipman earlier claimed to have found living bacteria in pre-Cambrian and in Pliocene rocks, also in anthracite coal formed 250,000,000 years ago. Unfortunately, very careful repetition of Lipman's work failed to confirm his findings.

At some time or another, all of us have read about the remarkable mummy wheat which is said to have retained its power to germinate despite burial for centuries in the tomb of an Egyptian mummy. But plant specialists say that wheat grains could not even retain their shape and form after such a lapse of time, much less their power to germinate. Wheat does retain life, or power to germinate, for about 15 or 20 years, but that is all.[1]

On the other hand, when Captains Stevens and Anderson made their ascent into the stratosphere they found that many micro-organisms displayed remarkable resistance to adverse conditions. These were mostly tiny spores that cause a number of plant diseases. But, exposed to terrific cold, extremely reduced atmospheric pressure, and sup-



**Female dog tick. After two years of starvation it apparently is as heavy as ever. Feminine readers on reducing diets will sympathize**

posedly lethal ultra-violet rays—all unprotected—they retained their power to generate and grow when returned to the laboratory.

There are also authentic records of the power of certain organisms to persist incredibly long times without food. Dr. F. C. Bishopp, of the United States Department of Agriculture, discovered that the dog ticks responsible for the spread of Rocky Mountain spotted fever are disgustingly hardy. In June, 1936, he wrote: "They can live from year to year with no food. Adult ticks put in vials without food on April 10, 1933 for observation, are still alive and vigorous." If this tick completes its career it eats thrice, gorging with blood as pupa, larva, and adult, and it can live a whole year without food between stages, while record longevity for an adult is 988 days. I have seen ticks in a glass tube, quite motionless, that had lived a year foodless. They do not move, when starved, unless disturbed or warmed up by holding the tube in the hand. They do not change in appearance. They apparently weigh as much after two years of starvation as when it all began. They do not have the kind of tracheal equipment that a true insect has, hence oxygenation is possibly minimum in any case and metabolism can be reduced nearly to zero; but they do finally die if starved persistently. Spiders will live foodless in a tube four or five years and be as spry as ever.

The life duration of the much-studied fruitfly is also rather considerable when no food is provided. It depends on what is called their "inherent vitality," that is, their power to live when starved. The life curves of a population of these flies are the same when they are completely starved as when they are fed, and they tend to die off at about the same rate. This is in part because complete starvation renders the density of population impotent to exert its usual bad effect on the life curve.

DR. C. M. McCAY and his associates have presented evidence to show that mild starvation in youth will almost double the life span of the laboratory white rat. Scientists at Brown University found the same thing true of the water flea, the insect averaging a life 50 percent longer when its food supply was reduced. Of course, many lower organisms change their size, shape, or even their general bodily condition radically when starved, and so adjust themselves to life at a reduced energy value. Thus, certain jellyfish become spherical when starved, while many other organisms dry out and persist as what might be regarded as dust until, months later, they are moistened again and live.

Temperature has a tremendous effect on life. Generally speaking, the warmer things are, the faster the organism lives and the quicker it dies. The normal range of temperature within which life is theoretically possible is surprisingly narrow, but certain organisms show a power just as surprising to surmount this little difficulty. Certain bugs and insects manage to survive fumigations with hydrocyanic acid if the temperature is low, as they go into a lethargic state which renders them resistant to poison.

Intense heat will also make some insects go into a sort of coma during which they are strangely resistant to

[1]One explanation is that, in some cases, tourist guides have "salted" the tombs with good modern wheat, then "discovered" it in the tourist's very presence. Such wheat will germinate, especially if the tourist pays well for it. —*Ed.*

lethal agents. At the other extreme, flies can be frozen stiff and solid, and left in the refrigerator some time, only to "come to life" when thawed out. As we shall see later, warm-blooded animals cannot withstand such drastic treatment.

Dr. Levi Noble, a student of volcanoes, reports that certain algae (single-celled lower organisms) manage to live in volcanic springs that are perpetually very little below the boiling point of water. Here is a remarkable adaptation to temperatures that are normally assumed lethal. Dr. Noble raised the question whether life might not occur on some of the hotter stars, now supposed to be lifeless, which would show a further adaptation to high temperatures.

Human beings rarely can resist a body temperature much above 105 degrees, Fahrenheit. Those reported to have higher fevers that persisted were ultimately found to be hoaxes. The proteins forming the vital tissues of human beings tend to coagulate at higher temperatures, somewhat as egg proteins coagulate on boiling. This process is not reversible and death ensues.

WHAT about the effect of lower temperatures? The British scientific journal *Nature*, in December, 1936, reported experiments wherein fish had not resisted cooling to one degree, Centigrade, below freezing—when the water around them was permitted to freeze. If the water could be supercooled to three degrees below zero, Centigrade, but still not permitted to freeze, the fish survived the ordeal. Hence it was concluded that the fish perished mainly because ice formed in their bodies, not simply from the effect of low temperature.

Lower organisms, like the afore-mentioned flies, definitely can resist phenomenally low temperatures. Dr. C. A. Magoon, of the United States Department of Agriculture, reports that many micro-organisms are not destroyed by freezing. Indeed, some microbes resisted temperatures as low as minus 422 degrees, Fahrenheit, for a period of ten hours, a few survivors returning to full activity thereafter. Yeast and molds were used in this work.

The eggs of the roundworm develop and become infective, according to workers in the same department, after being exposed to minus 16 degrees, Fahrenheit. The eggs also survive burial for a year, immersion in strong solutions of powerful chemicals, and treatment with many of the commonly used disinfectants.

Reports that frogs have been frozen solid at the beginning of a lecture period, only to thaw out and hop in a sprightly manner around the professor's desk at its ends, are taken with a grain of salt. Dr. D. Fraser Harris, of Dalhousie University, reported such an occurrence in 1922, but the frog was surely not frozen clear through. Dr. Harris also reported that fish could be frozen quite solid, sawed in half while frozen and then, upon thawing the halves, these would show signs of latent tissue life. This seems scarcely credible and would make most biologists lift a quizzical eyebrow. The external tissues of the frog may have been frozen, but it is certain that the heart still functioned and that, if the heart ever froze stiff, the frog would be very permanently dead, for freezing breaks down the cell tissues of plants and animals; it destroys their protoplasm. It disintegrates and disperses the vital cell contents. Ice crystals have enormous power to destroy. It is true that modern quick-freezing processes result in ice crystals so small as not to damage the palatability of foods, but even this process would destroy life.

Government entomologists shipping insects in cold storage, so that they may be used to prey on other insects. This method is very common

There is no scientific reason whatever to suppose that any warm-blooded animal could survive through-and-through freezing. Life would be extinct after the thaw, no matter how rapid the freezing process. Hence it is just as well not to believe press stories about frozen monkeys which returned to full life and activity after being thawed out.

Temperature does, as was said earlier, affect the rate of living. Frog eggs develop into tadpoles and frogs much more quickly at higher than at lower temperatures. The duration of life of flies, from egg to death of the fly, varies greatly with the temperature; whereas it may be but 21 days around 85 degrees, Fahrenheit, it may rise to 177 days at 50 degrees.

An energetic scientist figured out that, if human beings reacted to temperature as do flies, the average healthy man would attain the age of Methusaleh, if his body temperature were but 60 degrees instead of about 98. If the body temperature could be reduced to 45 degrees the man could pursue his slow-motion life nearly 2000 years. As a rule, lethargy increases but life persists longer at lower temperatures.

A bacterium that causes intestinal trouble will grow actively at about 50 and also at 115 degrees, Fahrenheit, but it reproduces 30 times as fast at the latter temperature. If an actively growing colony at the lower temperature is transferred to the higher, there is a distinct lag before more rapid reproduction takes place. If the transfer is made the other way around, nearly all the bacteria die when first exposed to the lower temperature.

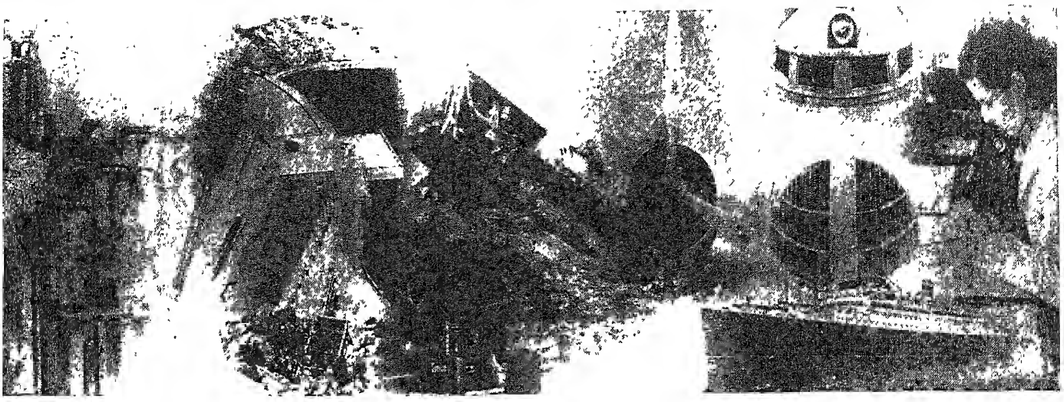
Meanwhile, the biologist's old standby, the fruitfly, has a larval period of only six days at 76 degrees, Fahrenheit, but the period expands to 18 days if the temperature be lowered to 58 degrees. Salamanders take 11 weeks to metamorphose at 76 degrees but require 22 weeks at 58 degrees. Broadly speaking, a colder life means a longer one among such organisms.

DEGREES of aliveness differ. There is a condition of "latent life" wherein even warm-blooded animals may hibernate while reducing their oxygen consumption enormously and evolving little or no heat. Small rotifers, many-celled aquatic organisms, will also seemingly die if dug out of the mud and dried but their life remains latent, for they resume it when returned to the mud.

Bacteria, fungi, and sea organisms can also survive drying and considerable heat, while entomologists tell us that Bobby Burns' inspiring louse could withstand freezing for seven days, retaining latent life. It has been suggested that East Indian trance experts voluntarily assume some such state as that of the hibernating bear, thus rendering life latent. Tortoises, hedgehogs, dormice, and marmosets have also mastered this art.

Stories of frogs found alive in walls and ancient rock formations are not credited by biologists but the stories show greater "persistence of life" than any animal yet known. A frog can assume a hibernating state for a few months or a year. In most cases the frog was "salted," like the mummy wheat.

We may conclude, then, that the lower the scale of existence the greater the resistance to lethal agents. Man and the warm-blooded animals pay for their greater complexity and their higher endowment by being more easily destroyed than certain cold-blooded animals, insects, and micro-organisms. All stories of phenomenal resistance to lethal agents displayed by higher organisms must be viewed very skeptically. Such things are possible, however, with lower organisms, though even then the strange tales told sometimes cannot be true.



# THE SCIENTIFIC AMERICAN DIGEST

**Conducted by F. D. McHUGH**

Contributing Editors

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Chemical Engineer

## Cutting the Jonker

OF all the great diamonds in the world's history, the Jonker is the second to be cleaved. The other was the Cullinan, found in 1905. All other great stones from the beginning of recorded gem history were merely trimmed, most of them crudely. In past ages, the tendency was to sacrifice beauty and workmanship for more weight: today weight is sacrificed for beauty, purity, and perfection of cutting.

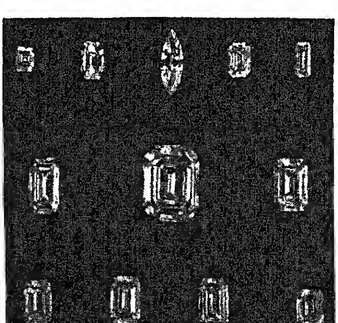
Jonker Diamond Number One, weighing 143 carats, will undoubtedly go down in jewel history, not only because of its size, but because of its perfection and its magnificent blue color. It is exceeded in size by the Star of Africa and the Cullinan Diamond, both in the British Crown collection, but in color it far surpasses both.

The Jonker Diamond weighed 726 carats in the rough and has now been cut into 12 perfect diamonds, the total weight of which is 375 carats. The other 351 carats has been polished away into dust of little or no value. Weight had been sacrificed at every turn to make each diamond a master-the Jonker diamond was done by Lazare Kaplan and his son, Leo, for Harry Winston, a New York jewelry dealer. After months of study of the cleavage planes the diamond was cut, and the Jonker luck tradition held. Then followed months of additional study, and then anxious months of sawing. The saw was a whirling phosphor-bronze disk which operated at 5000 revolutions per minute.—*Copper and Brass Bulletin.*

## Dry Ice from Power Plants

A NEW method of purifying carbon dioxide from the dilutions ordinarily found in power-plant flue gases promises to make the manufacture of dry ice a profitable by-product of electric power production. Heretofore, the methods available for recovering carbon dioxide from flue gases have been uneconomical to use except where special coke fires produced the gas in high concentrations. The newly patented method consists in introducing a small amount of ammonia into the customary potash lye solving a larger proportion of the carbon dioxide in the lye. In this way ordinary power plant chimneys may be made to give up their carbon dioxide economically, and off-peak power can be used to convert the purified gas to solid form for use as a refrigerant. Production of dry ice by power plants near centers of population where demand is greater will save part of the large losses now incurred in handling and shipment from distant producing points.

—*D. H. K.*



*Left above:* Marking cleavage lines on the rough Jonker diamond. *Above:* The 12 diamonds, weighing 375 carats total, that were cut from the Jonker. *Right:* Cleaving a piece of the diamond with a sharp blow

### HEALTHIER PLANTS

**SEVENTEEN crops are now worth about 66,000,000 dollars a year more because disease-resistant varieties replaced older ones. Some of the more conspicuous cases of gains from disease resistance are found in wheat, flax, sugar cane and sugar beets, lettuce, and cantaloupes.**

## "Fish-Eye" Camera Studies Winds

A PHOTOGRAPHIC method of charting the night winds high above the earth, to determine direction and velocity for weather forecasting and aircraft operations, has been worked out in the meteoro-

## A. Russell Bond

IT is with sincere regret and a sense of personal loss that we report the death in May of Alexander Russell Bond, patent attorney and an editor of Scientific American for nearly 20 years. A graduate of Princeton, Mr. Bond became Associate Editor of Scientific American in 1902 and ended his connection with this magazine as Editor of Scientific American Monthly in 1921. Since that time, he held a number of important positions in connection with patents and invention, and at his death was a practicing patent attorney. He was 61 years of age.

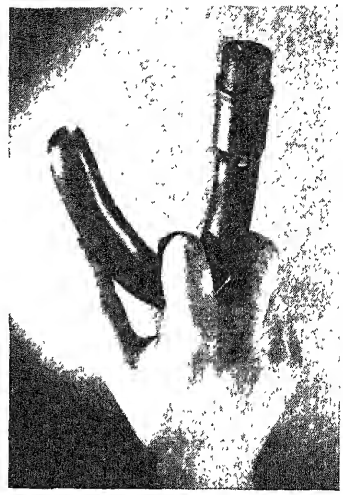
Mr. Bond wrote many books, some of which were published by Scientific American. Among the latter were several which enjoyed a large sale, including "The Scientific American Boy," "The Scientific American Boy at School," "With the Men Who Do Things," and "Pick, Shovel and Pluck." He collaborated with A. A. Hopkins, another editor of Scientific American, on the "Scientific American Reference Books" of 1904 and 1912.

logical laboratory of the Massachusetts Institute of Technology.

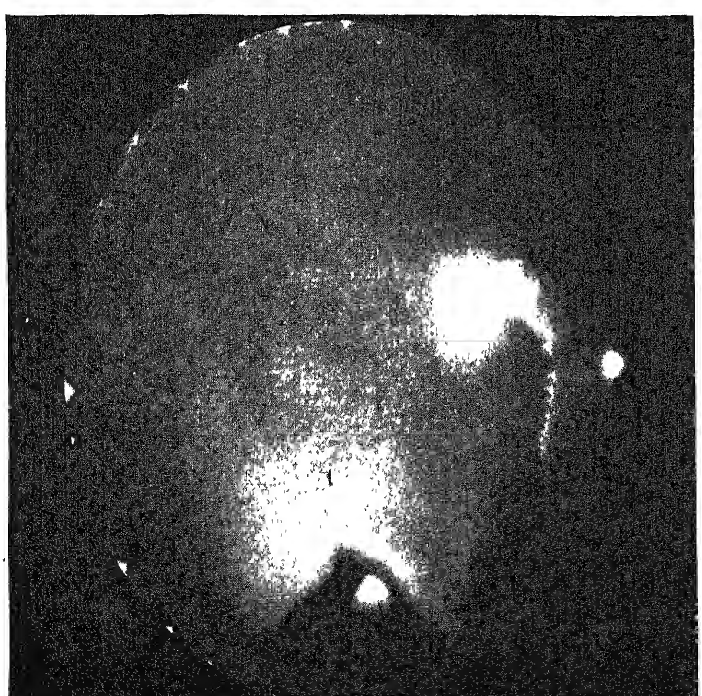
Devised by Athelstan F. Spilhaus, of the Woods Hole Oceanographic Institute, who is now carrying on research at Technology, the photographic method of nocturnal wind soundings makes use of a "whole sky camera," which has a 180-degree lens, sometimes known as a "fish-eye" lens; a pilot balloon; and magnesium flares attached at intervals to a length of ordinary blasting fuse. From an observation point on the earth the camera lens is pointed upward and as the sounding balloon ascends, the flashes of the magnesium flares, ignited at known intervals, are recorded on the plate. The photograph taken by the 180-degree camera is circular, the circumference depicting the horizon all around, and the brilliant magnesium flashes are registered on the plate regardless of the direction in which the balloon moves. Thus, by measuring the angles of elevation and direction between the camera station and the flashes, and correlating this data with the rate of ascent of the pilot balloon, an accurate record of the wind velocity and direction is obtained.

At night, it has been the practice to suspend a paper lantern containing a candle from a balloon and to train a theodolite on the light. The disadvantages of this method, however, are that the light is extremely dim and is frequently lost in a short time. Observers have also been known to confuse the faint light of the lantern with stars. The Spilhaus method makes it possible to take readings photographically at very brief intervals and the apparatus may be used by inexperienced observers.

Preparing the night sounding balloon. The white spots on the blasting fuse "tail" are magnesium flares



A new flexible gasoline hose nozzle fits the filler tubes leading to the gasoline tanks of modern automobiles, and permits filling station attendants to serve gasoline with minimum danger of spilling. The nozzle is of Thiokol, a rubber-like material unaffected by gasoline



### LIQUEFIED GAS

SEVEN years ago the national consumption of liquefied petroleum gases totalled about 18 million gallons per year. In 1936, the quantity used was 106 million.

## Most Powerful Weapon Against Pneumonia

THE most powerful weapon the modern physician can use to fight pneumonia is specific immune serum, Dr. Edward L. Bortz, of the Post-Graduate School of Medicine of the University of Pennsylvania, recently told doctors at the Post Graduate Institute of the Philadelphia County Medical Society and the First District Councilor Meeting.

Describing the dramatic results obtained with serum in treating pneumonia, Dr. Bortz said: "From a desperate, acute, consuming illness with a dangerous temperature, chest pain, restlessness, paroxysms of cough, and approaching delirium, the prompt administration of the correct serum will sweep away the toxemia, the temperature will fall, the pain in the chest will disappear, the pulse and respiration will return to normal, the cough is quieted, and the patient finds himself practically a well man, emerging as it were, from an evil dream."

Turning to statistics, Dr. Bortz said that the high pneumonia death rate can be cut at least 50 percent by modern treatment, which means prompt diagnosis and treatment with the appropriate serum. Diagnosis

the many pneumonia germs is causing the disease in a particular case. This test is called typing and the germs are known respectively as Type I pneumococcus, Type II pneumococcus, and so on for all the different members of the pneumonia germ family.

Unfortunately, curative serums have not been developed for all the pneumonias, but where they have, their use will save thousands of lives.

Nutrition, elimination, rest, and nursing care are other important factors in the treatment of pneumonia. Dr. Bortz said that oxygen is an important aid, but that its use "has unfortunately not affected the mortality rate."—*Science Service.*

**STRONGER**

**STEEL chains seven-eighths of an inch in diameter, when alloyed with nickel and molybdenum, are three times as strong as unalloyed chains of the same size.**

## Drilling and Tapping Bakelite

MACHINING—especially drilling and tapping—Bakelite products, is hard upon milling cutters, drills, and taps. It is also difficult to get good threads, and clean, small-sized holes. Drilling and tapping sheet and molded Bakelite is greatly facilitated when carbon tetrachloride is used as a cutting lubricant. It is possible to tap 8–32 holes in ¼-inch laminated stock at a relatively high speed without stripping threads or producing ragged edges, when the tap is kept moist with carbon tetrachloride. Tap wear is very greatly reduced when this fluid is used. The chemical reasons why this should be a good cutting fluid are not understood.—*Shop and Laboratory.*

## Car Driving in the Curriculum

BELIEVING that instruction in the theory of the rules of the road and actual practice in driving a car has a place in the curriculum of the present-day high school as a means of promoting highway safety, the American Automobile Association last fall sponsored a Driver Training Program which already has met with great success in ten high schools in various parts of the country.

Arrangements were made whereby Professor Amos E. Neyhart was granted a leave from Pennsylvania State College in order to direct this educational program for the AAA. Professor Neyhart has been developing this program for the last five years and today instructors in Driver Training Programs are selected as far as possible from 135 graduates who have specialized in driver training at Penn State.

Two sets of clutch and brake pedals

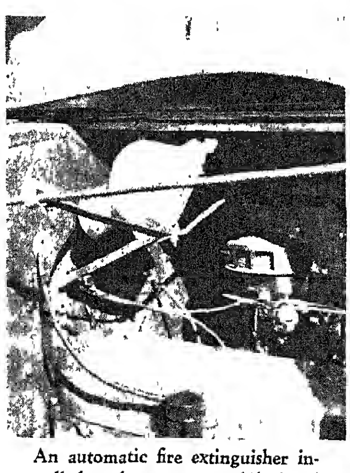
Actual automobiles are used to make the road instruction practical. In this phase of the program, Pontiac Motors has co-operated with the AAA, furnishing training cars for each high school. The cars are painted white with special "AAA Driver Training" lettering and a set of dual-control clutch and brake pedals is installed in the right hand front seat position for use of the instructor. These dual-control pedals are directly connected with the driver's regulation pedals.

With dual-control pedals mishaps are prevented while the student is driving as the instructor can throw out the clutch and apply the brakes instantly. Also, correct clutching, braking, and the proper shifting of gears are learned more rapidly by the student.

# TRANSPORTATION SECTION

## Versatility in Fire Extinguishing

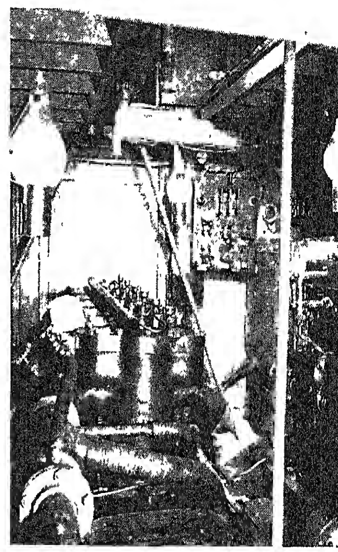
OF particular interest to the motor boat and automobile owner, but equally useful in the home, store, or factory, is a versatile fire extinguishing system that may be used manually or automatically, and



**An automatic fire extinguisher installed under an automobile hood**

which will set off a local alarm or a wired alarm at the outbreak of a fire. Essentially the AutoFYRstop, as this system is called, consists of a 14- or a 36-ounce glass bottle containing carbon tetrachloride and held in a bracket. For manual operation, the bracket is merely a holding device; for automatic operation, a thermo-responsive fuse in the base of the bracket releases a spring-impelled hammer mechanism when the surrounding air reaches a predetermined temperature. This hammer mechanism bursts the sealed glass bottle and releases the fire extinguishing carbon tetrachloride. [illegible] desired, the system can be equipped with an electric switch, which is actuated by the same means as the local alarm and which permits an entire installation of unit devices to be wired together in series and connected with a centrally located alarm and annunciator panel.

For manual operation, the fire extinguishing bottles are located at convenient points. At the start of a fire a bottle is removed from its bracket, the tip broken off, and the liquid sprayed over the fire. Alternately, the bottle may be hurled at the base of the flame where it smashes and releases the liquid. This same type of manual operation



**New type fire extinguishers in the engine room of a large motor boat**

may be used with the automatic device; the glass bottles are independent units. When one of the devices goes into operation automatically, nearby people may collect bottles from other automatic units and bring them to the point of fire, concentrating the action of the fire extinguishing fluid.

This fire fighting system has been approved by the Underwriters' Laboratories and by the Pennsylvania and City of Philadelphia Fire Control Authorities.

**BRAKES**

**THE leading maker of coaster brakes for bicycles reports that 7000 brakes per day, or 2,000,000 brakes a year, are being turned out as against an average of 400,000 per year, the normal production rate until recently.**

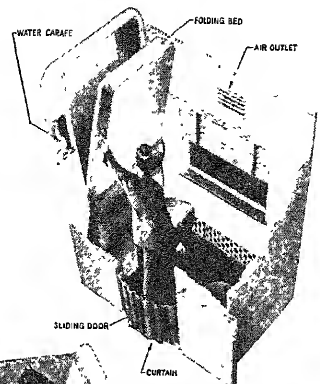
## New Pullman Luxuries

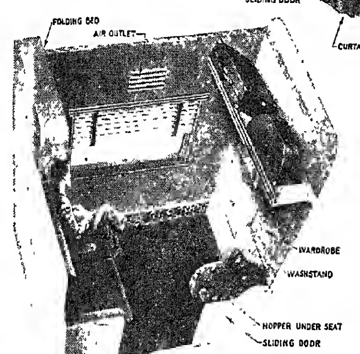
THREE new and radically different accommodations, all of the private room character, have been announced by the Pullman Company. All of these new-type accommodations will be found in the equipment now being built for the North Western-Union Pacific-Southern Pacific streamliners

Central's *Twentieth Century Limited* and the Pennsylvania's *Broadway Limited.*

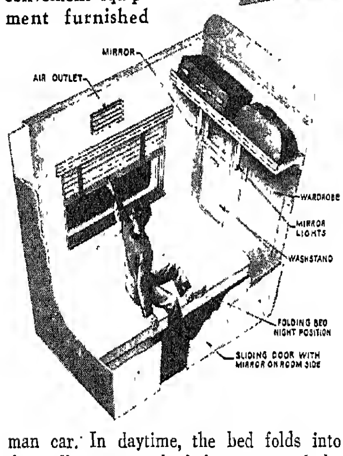
Two of these accommodations will bear the drawing room and compartment designation familiar to Pullman patrons, but important new features have been devised for the new-type rooms. The third accommodation is called the "Roomette," and it is new from top to bottom, including the name.

The "Roomette" is a small, completely enclosed, private room within the space of a section, containing one bed. Eighteen "Roomettes" can be placed in one Pull-




***Above:* Lowering the bed in the "Roomette" is easily accomplished. *Left:* The room in use during the day, with bed out of the way**




***Below:* The new Pullman "Roomette" made up for sleeping, showing convenient equipment furnished**

man car. In daytime, the bed folds into the wall at one end of the room, and the passenger has a sofa seat of the latest and most comfortable contour, with ample space for lounging, or for undressing before the bed is lowered for the night-time arrangement. For dressing, the passenger can make the whole room space and its complete toilet facilities available by returning the bed to its niche in the wall. The slightest effort will accomplish this, and a safety ratchet eliminates any danger of the bed falling during the operation. When the bed is made down for the night it is fastened at the foot by an automatic lock. This is easily released when the passenger desires to raise the bed, and the lock then reverses and holds the bedding in place. The size of the bed, 6 feet 5 inches in length, will appeal to persons of any height.

The door of the "Roomette" can be locked at night, or left open and a curtain drawn across the opening. The patron has many conveniences, such as individual regulation of ventilation, heat, and light; complete toilet facilities, with washstand folding into one wall, and above it a mirrored cabinet for toilet articles, with tubular lights on each side; a locker in which to hang clothes; a large rack for luggage; a vacuum water bottle in a niche at the bed head; and a box from which the porter can remove

ing and reading lights of new design provide ample illumination. One daytime novelty is an adjustable footrest that can be pushed aside when not desired.

As the "Roomette" is completely air-conditioned the passenger can enjoy his pipe, cigar, or cigarette, knowing that the smoke will be withdrawn almost immediately through a grilled outlet, and without discomfort to those in adjacent "Roomettes."

## Most Powerful Passenger Steam Locomotive

M. W. CLEMENT, President of the Pennsylvania Railroad, announced recently that the company is now engaged in developing a new and distinct type of steam locomotive which will be capable of hauling 1200 tons—a 14-car passenger train—at 100 miles an hour. It is expected that this locomotive will combine power, speed, and economy of operation to a degree never before achieved and will anticipate railroad locomotive development for years to come.

The new locomotive will be known as "The Pennsylvania Type." It will be a development of the conventional coal-burning steam locomotive, which with improvements in design and efficiency will cost little more to build, operate, and maintain than present locomotives of lesser capacities. The design is being developed by a committee of engineers of the Baldwin, American, and Lima Locomotive Companies co-operating with the railroad company.

While designed primarily for passenger service, many of the improvements embodied in the new locomotive are expected to be readily adaptable to freight operations, where increased power and speed over present freight locomotives will be of equal advantage and where comparable improvements, efficiencies, and economies will be introduced.

Concurrently with this new forward step in the design and utility of motive power, the Pennsylvania is progressively introducing improvements in road-bed and track, in types of passenger- and freight-car equipment, in signals and other features of operation, all looking toward the inauguration of new conditions of safety, dependability, speed, and comfort in passenger- and freight-train service.

In contrast with the present heavy-duty passenger locomotive, "The Pennsylvania Type" will have four cylinders instead of two, each pair of cylinders providing power for two pairs of driving wheels. The locomotive will obtain coal and water from a tender mounted on two six-wheel trucks, carrying 25,000 gallons of water and 26 tons of coal.

As soon as one of the new type locomotives is completed the railroad plans to conduct exhaustive tests, both in test plants and in actual road service, to determine its practical adaptation to the Pennsylvania's varied transportation service.

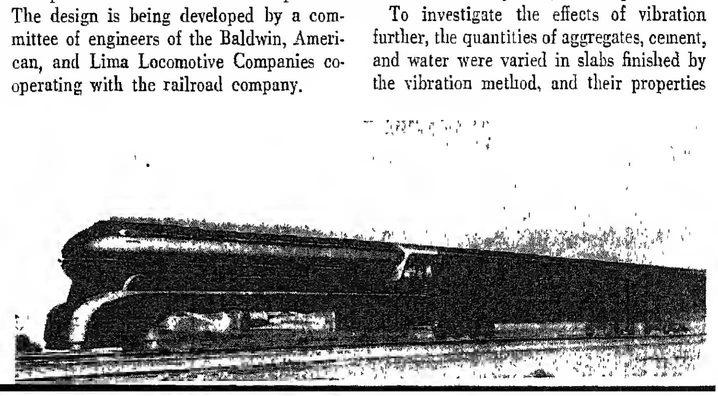
## Vibrating Concrete Adds to Strength

VIBRATING concrete as it is laid in a pavement increases the strength 10 percent, according to a report by the Bureau of Public Roads of the United States Department of Agriculture; or, by vibrating, 10 percent less cement can be used, and the same strength maintained. Vibrators work on somewhat the same principle as those used in giving beauty treatments.

The report gives the results of an investigation recently conducted at Arlington, Virginia. Two hundred and seventy slabs of pavement, each ten feet wide and eight feet long, were constructed and tested. Four different types of vibrating equipment were used, their speeds varying from 3600 to 4000 vibrations per minute.

Slabs of similar composition were placed and finished by standard methods without vibration. Thus, differences in the strengths and physical properties were directly attributable to vibration. In every instance it was found that vibration increased the strength and density and decreased the amount of "honeycomb," or air pockets.

To investigate the effects of vibration further, the quantities of aggregates, cement, and water were varied in slabs finished by the vibration method, and their properties

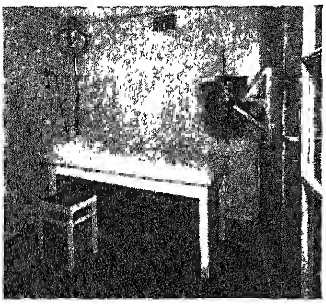


were compared with those of non-vibrated slabs. Slabs seven and ten inches thick were placed, and the effects of surface vibration were found to extend entirely through both.

The report describes ways in which existing specifications for pavement concrete can be modified to utilize vibration to advantage.

## Sea-Going Spa

THE newest thing under the sun and on the seas is now the floating spa offering on shipboard the baths and treatments of the world-renowned German health



resorts in addition to the natural curative properties of sea air in search of which so many make ocean voyages each year.

The motorship *Milwaukee*, operating in the Hamburg-American Line's cruise service out of Hamburg, voyaging south in the winter months and northward in the summer, has been equipped with the latest apparatus for hydro-therapeutic baths and treatments and has become a veritable health resort afloat, thus supplementing the pleasure cruise with the opportunity to improve one's physical condition still further.

The *Milwaukee's* spa comprises 10 distinct departments, and among the hydropathic treatments provided are Turkish baths, brush baths, medicinal baths of all kinds, and douches of various types. The massage treatments given include subaqueous pressure massage, Swedish massage, vibratory massage, and the like, while among the electric and ray applications available are ultra-short waves, Stanger baths, ultra-violet rays, cadmium light, blue light, Sollux lamps. The facilities provided also include a sub-aqueous intestinal or Suda bath, an inhalatorium, medico-mechanical treatments, and then, of course, physical culture and sports in the swimming pool, the gymnasium, and on the sports deck. In addition, there is a special dietary kitchen equipped to cater to as many as nine different diets, and the healing waters of Germany's most famous mineral springs are available at all times.

*(End of Transportation Section)*

*Above and left:* Two of the rooms in the latest in sea-going spas

## A New Red Pigment

BY utilizing the ability of one substance to change the crystalline form of another, a new red pigment useful in oil paints and varnishes, nitrocellulose lacquers and printing inks, has recently been made by a process very similar to that yielding chrome yellows. In manufacture of chrome yellow, a mixture of lead chromate and lead sulfate is precipitated from a lead solution and by varying the conditions of the precipitation a variety of shades of yellow can by X-ray studies to be the influence of white lead sulfate on the crystalline form of the yellow lead chromate. Still further changes in crystalline form which yield deep orange to scarlet pigments are produced by simultaneously precipitating white lead molybdate with the lead sulfate-chromate mixture. Lead chromate crystals precipitated in the presence of lead sulfate vary from lemon colored rhombic to reddish yellow monoclinic types. The simultaneous precipitation of lead molybdate changes these to tetragonal form which becomes progressively redder.—*D. H. K.*

## Free Flight in a Tunnel

THE tradition at Langley Field is that at least one piece of new research equipment shall be presented to the visitors at each Conference. This year there was adherence to this tradition in the form of a "Free Flight Tunnel" which is illustrated in one of our photographs. Air is drawn into a small and short tunnel of rather crude design through a fine mesh cloth to secure satisfactory air-flow. The whole tunnel is hinged at a point above the apparatus, and a vertical strut, placed below and operated by an electric motor and worm gearing, tilts the whole tunnel up or down.

When the tunnel is tilted upward, the air flow also has an upward component. Then, as the speed of flow is increased, a model which is placed on the floor of the tunnel rises and glides against the forward and upward flowing current. The model soars indefinitely in the tunnel, just as a glider soars indefinitely in the rising air current on the side of a cliff.

Control surfaces are actuated by small electro-magnets carried in the model; and the research worker, by manipulating the electric current, can move the controls and put the model through various maneuvers. Wind gusts are simulated by tilting the tunnel rapidly up or down. Photographic apparatus adds to the visual observations of the behavior of the model.

While the "Free Flight Tunnel" can never supplant the more scientific methods where the model is held stationary in a large tunnel on wires running to recording balances, nevertheless it will be invaluable for rapid study of stability and control, and should be most useful also for teaching purposes.—*A. K.*

## Curtiss Electric Constant-Speed Full-Feathering Propeller

THE new Curtiss aircraft propeller, which has been in process of development for several years, has a name that is long, but necessarily so because it alone fully defines the functions of this interesting device.

Controllable pitch propellers as developed to date may be roughly classified as follows: 1. Manual, purely mechanical control; 2. Mechanical control, with a governor to provide constant speed; 3. Manual operation of a hydraulic control system; 4. Hydraulic actuation in conjunction with a governor, to provide constant speed; 5. Automatic variable pitch propellers, in which centrifugal force, aerodynamic forces, and sometimes springs have been combined to secure the required result. This classification is not complete but serves to give an idea of the various lines of attack which have been followed.

The Curtiss propeller combines electrical

N.A.C.A. free-flight wind-tunnel in which the model is unrestrained and flies

pitch-variation with constant speed obtained by the aid of a mechanical governor.

But it is not only in electrical actuation that the novelty of this device appears. There are two other valuable features: one is a flexibility which permits either automatic constant speed or selective manual control in the same installation; the other is the ability to feather the blade through a very wide range of operating angles.

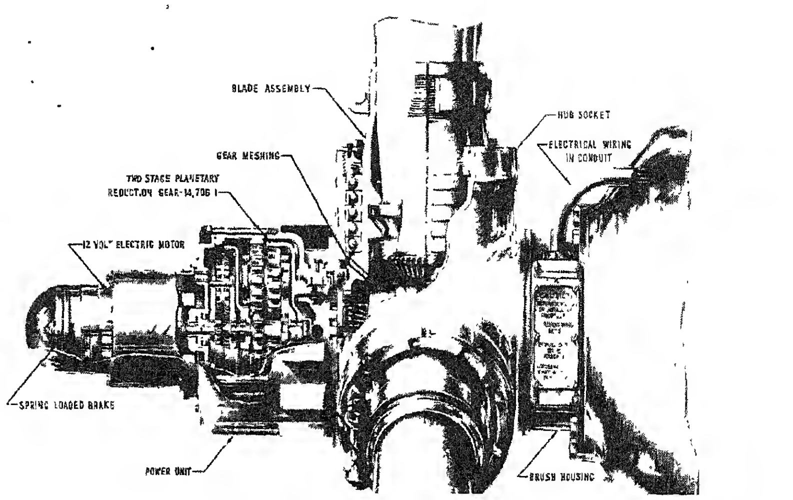
The range of blade angles is helpful because of the very wide range of speed in the modern airplane, and also because when one engine of a multi-engine installation goes out of commission, it is advisable to prevent the propeller from windmilling. It should be "feathered" to 85 or 90 degrees so that it offers the least air resistance. Then the power unit which has gone out of commission takes the least possible drag power, and the remaining power unit or units can most readily keep the airplane going steadily forward. The hub construction and blade retention system of the Curtiss propeller are such that the blade angle movements are as great as 120 degrees, sufficient to cover all conceivable requirements on land, water, or in the air. It is a further advantage of the propeller that the pitch actuating mechanism is completely enclosed and protected from temperature changes, moisture, and icing conditions.

The general construction of the propeller is shown in the accurate, though partially schematic, diagram. The hub proper is of the one-piece type, machined from a high alloy steel forging. On its rear extension is mounted the slip-ring assembly which transmits electrical energy from stationary brushes to fixed contacts at the front face of the hub.

A Martin bomber with the new electric controllable-pitch propeller

The fixed brush assembly consists of a pair of spring-loaded carbon composition brushes for each slip ring, mounted in a block of insulating material and supported by a light alloy casting bolted to the thrust cover of the engine nose. This casting completely houses the electrical parts.

Pitch change is effected by means of a 12-volt electric motor (series wound, reversible, direct-current type) mounted at the nose and operating through a planetary which engages a bevel gear fixed to the root of the blade. The reduction gearing embodies the enormous reduction of 14,706 to 1. Thus, with the electric motor turning quite rapidly, the most delicate pitch change is imparted to the propeller blades, which are three in number in the installation shown.




*Above:* **A partial sectional drawing of the Curtiss electric constant-speed full-feathering propeller.** *Below:* **The propeller hub casting with slip rings on the rear extension**


The normal pitch range of the blades is controlled by electrical cut-out switches operated by a cam on the shaft with the power bevel gear.

The constant speed control consists of a conventional flyweight type governor driven at engine speed. The flyweight force is balanced against a spring, the initial compression of which may be adjusted by the pilot in selecting the desired engine speed. When the speed is balanced the pitch-changing circuits are open and no change takes place. When the speed is above or below that desired, the flyweights, through a plunger, actuate a switch to close the pitch-changing circuit.

The propeller has successfully passed both Army and Navy tests and has received the Approved Type Certificate from the Department of Commerce. It is a splendid addition to the resources of modern aviation. —*A. K.*

## The Langley Field Conference

As usual, the Langley Field Annual Conference of the N.A.C.A. was well attended by representatives of the aviation industry, the Universities and the Government wealth of research information was offered to the visitors. Space will permit only the most concise presentation of the outstanding achievement of the Committee's staff.

The eight-foot diameter, 500 mile an hour wind tunnel is now in perfect shape, and with its automatic balance is remarkably rapid in operation. It will be invaluable in advancing the study of high-speed flight in general and compressibility effects in particular. We have several times mentioned in these columns the "compressibility burble" of wing sections. When the air stream passing over a wing has a speed of say 500 miles an hour, the local velocity over the upper curved surface of the wing may be much higher, approaching the speed of sound; that is, 1092 feet per second. When the local velocity does approach the speed of sound, shock waves are created and the phenomenon of "compressibility burble" lowers the lift and increases the drag of the airfoil. Therefore, wing sections for high-speed flight may have to be radically changed in form to compensate for this effect.

Recent tests in the high-speed tunnel indicate that the N.A.C.A. engine cowl is subject to the same compressibility effects. When the air stream reached 325 miles an hour, the local velocity over the cowl attained 710 miles, a shock wave was formed, and the drag was increased enormously. The engine cowl will, therefore, have to have its leading edge much better rounded if airplanes are to fly much in excess of 325 miles per hour. In fact, a new type of cowl along these lines has already been designed.

In the near future aerodynamicists, inventors, and engineers will be busy designing new aerodynamic forms to avoid these shock waves.—*A. K.*

## Buying Used Airplanes

The *News Letter* of Aero Insurance Underwriters is always instructive, sometimes entertaining. The latest letter offers some sage advice on buying a used airplane. "When you purchase a used airplane be sure it has been inspected by a licensed mechanic who has certified to the condition and airworthiness of the airplane by signing his name in the log book. Be sure that the control surface bearings have not been reamed out until the remaining metal is dangerously thin. Examine the control wires for fraying, control tubes for

ever been in an accident and if so, see what replacements or repairs have been made. Look for corrosion under the soundproofing and especially at all important fittings. Try to get data on the history of the propeller; has it ever been bent and then straightened, and by whom?" Anyone who has ever bought a used automobile and lived to repent the purchase will appreciate the value of this advice!—*A. K.*

## An Automatic Supercharger Regulator

AIRPLANE pilots have so many gadgets to manipulate and so much to think of, that the strain of flying is severe. Control of the supercharger for altitude flying is another onerous task, since close watch must be kept over the intake manifold boost or

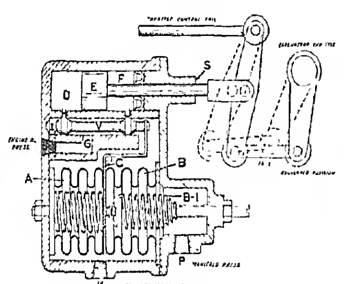



**Diagram of automatic supercharger regulator, explained in the text**

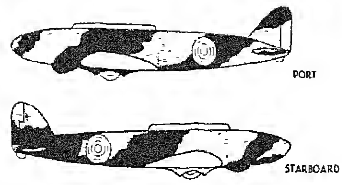
supercharger pressure to prevent the allowable engine output from being exceeded.

A two-position regulator developed by the Eclipse Aviation Corporation automatically maintains the maximum boost at take-off (when greater output is permissible and necessary for a short while) and also limits the boost under long cruising conditions.

The operation of the device is illustrated in the diagram. At take-off the pilot sets the selector lever in the cockpit at the "Take-Off" position and shoves the throttle full open. If the manifold pressure at full throttle on the ground is above the limit for which the regulator is adjusted, the manifold pressure, acting at P, expands the Sylphon B to the left against the action of the tension spring B-1. The sylphon B, when it expands to the left, carries the diaphragm C with it. The diaphragm in turn pushes the oil valve V to the left and admits engine oil under pressure through H into the servo cylinder D, forcing the piston E to the right, until the throttle setting is appropriately reduced. The converse operation when the manifold pressure is too low needs no description. The Automatic Regulator is functioning splendidly on many of our airlines.—*A. K.*

## "Shadow Shading"

THE British name for camouflage of airplanes, an art which was developed so highly by the Germans during the World War, is "shadow shading." The first principle observed by the Germans was to paint the upper surfaces dark and lower surfaces light, closely following the natural coloring of animals and birds. A simple model of a bird painted dark on the top surface and brilliant white beneath, with light falling on it from above, is invisible when seen from a short distance. For upper surfaces, the




**British "shadow shading"; a modern example of airplane camouflage**

mimicry," painting the upper surfaces in streaks or patches of dark green, dark brown, or russet, in the hope that they would take the colors of the earth below.

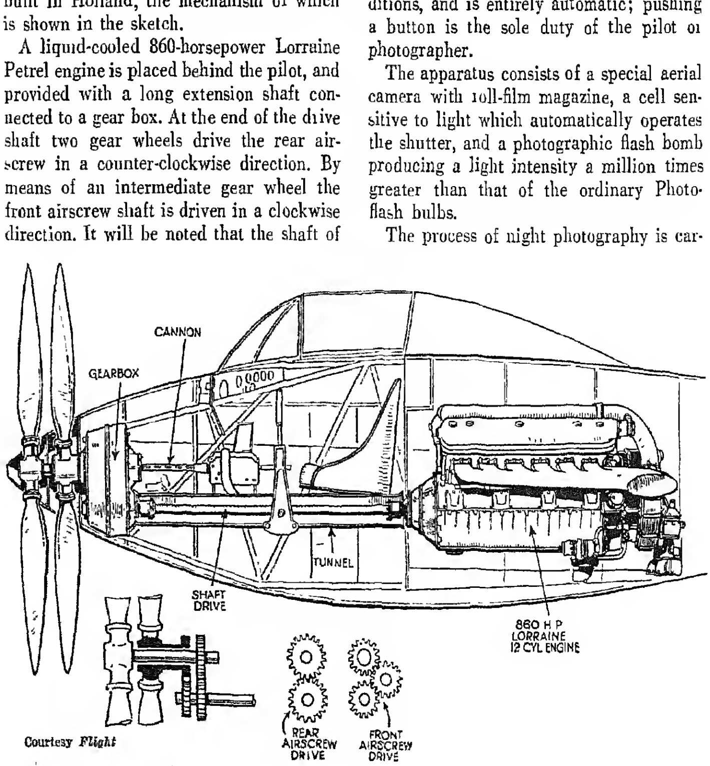
The modern British form of "shadow shading," as illustrated in the sketches which we owe to the courtesy of *Flight*, is based on very similar principles. The upper surfaces are covered with irregular patches of dark green and brown. So are the sides. The lower surfaces of the aircraft are finished in dull black known as "night," with a view to deadening the reflection of searchlights.—*A. K.*

## Screws Rotating in Opposite Directions

IN a single-seater fighting plane equipped with a powerful engine, the reaction torque of the propeller is so large, relative to the power of the ailerons, that there is considerable difficulty in maintaining lateral control at take-off; in flight the ailerons have to be set or the wings rigged to take up the torque, which is a source of aerodynamic inefficiency. Also, if a machine is trimmed to take up the torque, it is no longer in trim when the engine is shut off.

The remedy, frequently suggested, is to have two propellers rotate in opposite directions, so that torque effects are nullified. As our readers perhaps remember, one or two experimental machines along these lines have appeared in the United States. But none of these efforts has the perfect engineering finish of the Koolhoven Fighter, built in Holland, the mechanism of which is shown in the sketch.

A liquid-cooled 860-horsepower Lorraine Petrel engine is placed behind the pilot, and provided with a long extension shaft connected to a gear box. At the end of the drive shaft two gear wheels drive the rear airscrew in a counter-clockwise direction. By means of an intermediate gear wheel the front airscrew shaft is driven in a clockwise direction. It will be noted that the shaft of the front airscrew passes through the hollow shaft of the rear airscrew. The diagram indicates the simple mechanical principles involved. Mr. Koolhoven is of the opinion that the advantages of this airscrew system will more than compensate for the extra weight of the mechanism, the frictional losses in the transmission, and so on.—*A. K.*

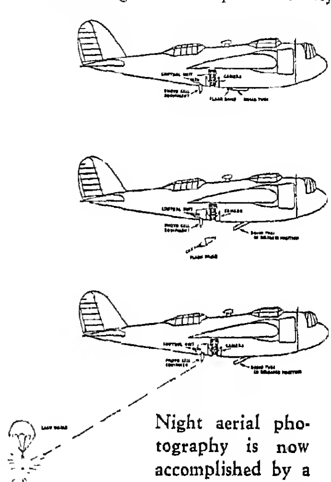



Courtesy *Flight*

## Aerial Photography at Night

FOR many years the Fairchild Aerial Camera Corporation has manufactured night photographic apparatus for the Army Air Corps, but it is only quite recently that this development has passed from the "secret" stage.

The apparatus will take photographs in the black of night that compare favorably



**Night aerial photography is now accomplished by a new system in which the flash is automatically ignited and the camera shutter is actuated by the resulting light. Drawings indicate the steps of the action**

with those taken under good daylight conditions, and is entirely automatic; pushing a button is the sole duty of the pilot or photographer.

The apparatus consists of a special aerial camera with roll-film magazine, a cell sensitive to light which automatically operates the shutter, and a photographic flash bomb producing a light intensity a million times greater than that of the ordinary Photoflash bulbs.

The process of night photography is car-

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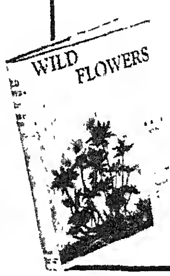


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ried out in three stages. In the first stage the aircraft is flown straight and level over the ground area to be photographed. The flash bomb is supported in the bomb rack of the airplane and is shielded against the slip stream and other air motion by an aluminum tube. At the appropriate moment, when the airplane is about 500 feet short of the center of the area to be photographed, the bomb-release mechanism is actuated and the flash bomb falls clear of the airplane, pulling a parachute with it. As the parachute opens, five or six seconds later, it offers greater resistance to the air than the bomb, and pulls an ignition tape while the slack lines are extending. Thereafter the parachute slackens the rate of descent. The fuse burns and at a predetermined instant the bomb explodes. This explosion occurs when the bomb is somewhat behind the airplane, which is continuing its forward flight. At the instant of operation, the bomb is outside the field of view of the camera but within the field of view of the light-sensitive cell. The cell thus actuates the shutter at exactly the peak intensity of the flash. With the short exposure coinciding absolutely with great light intensity, perfect photographs are achieved.

The artist's drawing illustrates the three stages of the process simply and accurately.—*A. K.*

## A Secret Fuel Feed System

A NEW fuel feed system, replacing the conventional carbureter and developed by the Stromberg Division of Bendix Corporation, is to be placed in service by United Airlines.

The announcement reads that the new system will have its chief advantage in greater dependability, and will eliminate ice formation without the necessity of high intake air temperatures.

Practically no other information is available. We may make a variety of conjectures. Perhaps direct fuel injection into the cylinders is in contemplation; or perhaps a variable section carbureter venturi is to be disclosed. Our readers may have other solutions to suggest.—*A. K.*

## Corn By-Products

CORN, which has been considered industrially as a source of starch, may yield important industrial by-products made from its protein constituents. At present the protein content of the corn finds its chief use in animal feeds, but attention has lately been called to the possible value of these important compounds in the manufacture of plastics, synthetic resins, and adhesives.

—*D. H. K.*

## Osculate at Your Own Risk!

CASES of inflammation of the lips due to hypersensitivity to certain dyes in lipsticks were reported by Drs. Joseph Goodman and Marion B. Sulzberger of New York at the recent meeting of the Association for the Study of Allergy.

By making tests of the various ingredients of the lipsticks, it was possible to discover

case, and to prescribe for the patient a lipstick which she could use safely.

Other cosmetics, notably powders and nail polishes, have also caused inflammation and skin irritation, the New York doctors found.

Dyes in wearing apparel, ranging from dresses to shoes and socks, frequently cause irritation in sensitive persons. This sensitivity is an individual matter, it appears from the cases reported. Some patients were sensitive to black, others to blue, and still others to brown.—Copyright 1937, *Science Service.*

## Shrinking Business

ONE of the most spectacular technical developments of the depression period occurred in the textile industry. While a search for new technical contributions and a defensive publicizing of older developments was being conducted almost frantically in the textile trade, an agricultural machinery inventor and engineer has quietly met a major opportunity and in the last three or four years the yardage processed by his treatment has increased some 60 percent annually. The development has been compared with that of fast color dyeing in its significance to the consumer and to the trade.

Shrinkage has always been a problem in textiles, but as the English authority, F. Courtney Harwood, notes, it became serious when the public began to prefer the use of soap to pomades and perfumes. Washing reduces the stretch of fiber and yarn which is introduced when the cloth is made, the cloth becomes narrower or shorter, and the garment becomes smaller in size than when purchased. Shrinkage was formerly considered a necessary evil, and garments were regularly purchased oversize to allow for it. Cotton slacks or suitings were out of the question. The modern vogue for slacks is only one of the changed customs that may be traced for credit or blame directly to the engineer, Sanford Cluett. Quite properly, the term "Sanforized," best known of the trade names for pre-shrunk fabrics, is spreading as a symbol of a new major consumer benefit. Certain other names indicate shrinking for which recognized companies take responsibility, such as "Banco-Shrunk," "Sayl-A-Shrunk," or that used by the Bradford Dyers Association Ltd., of Manchester, England, "Rigmel Shrunk." These and other registered names have begun to have some meaning in the trade and with the consumer who can check their reliability. The term "pre-shrunk" itself and its several trade modifications, however, are unfortunately all but meaningless.

The Sanforizing process was first used on a large scale for cottons and is especially well adapted for them but can be used for other textiles. The problem with woolens is complicated by the felting property of wool fibers, such that no practical pre-treatment of a woolen fabric can insure against shrinkage from all types of later use and abuse. Some of the difficulty is overcome by treating the wool with chlorine, and a recent English modification of this effect using chlorine in the form of a gas is hailed by its sponsors as an "unshrinkable" wool process.

The Sanforizing process is mechanical and in principle almost absurdly simple.

# THE AMATEUR TELESCOPE MAKER

Conducted by **ALBERT G. INGALLS**

LAST month in this department Professor Henry L. Yeagley, of the Department of Physics at the Pennsylvania State College, described his simplified equipment for aluminizing telescope mirrors. This month he completes his account with the actual working instructions, which are as follows—the "Figure 1, 2, and 3" he mentions below having appeared, of course, in last month's installment:

DIRECTIONS *for aluminization*· 1. Mount the rotary oil pump on four rubber "feet" (Figure 1) to prevent excessive noise.

2. Provide three ¾" upright supports topped with rubber cushions to hold the base plate (*I*, Figure 2) about 5" above the pump intake.

3. Assemble electrodes and exhaust port in position. Seal outer joints with vacuum wax. Place bottom disk in position and connect exhaust port to pump with rubber pressure tubing (*G*), then seal with wax.

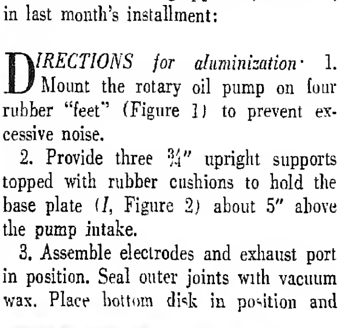


*Figure 4:* Mirror on its supports

4. Insert the release valve through a 1/16" hole cut in the rubber connector. Also, insert small plug in end of valve and seal both with vacuum wax.

5. Clamp 40-mil tungsten wire in position in electrodes, with a 3/16" overlap at middle and with slight spring action of the wire holding them together. Wrap 3" of .04" aluminum wire on this overlapping portion. Be sure to wrap evenly, and in about two layers, to provide as much metallic contact as possible.

6. Clean the glass mirror, as previously described, and clamp it securely in the three-metal-strip holder. Tinned iron from a large tin can is heavy enough for a 6" mirror support.

7. Heat the feet of the three upright supports *N*, and cement to the base plate *I* with vacuum wax. Support the mirror, face downward, on these posts, as shown in Figure 4. If properly made, this assembly forms an extremely trustworthy mirror support.

8. Carefully dust the inverted mirror with a "camel's hair" brush until no particles can be sighted when glancing across

9. Lower the bell jar or cylinder over the whole assembly and seal to the base, as indicated in Figure 3.

10. Start the pump and record the time. After pumping for five minutes, impress about 2000 volts across the filament-exhaust-port space. The initial discharge should spread itself over the metallic surfaces and gradually soften into a patternless grey-blue glow. In about 15 minutes this should occupy the whole space inside the chamber. If by chance there be a leak, no discharge will be apparent or it will not progress as described. In either case the remedy is simple; *i.e.*, heat all wax seals gently with the soldering iron until the discharge indicates a vacuum-tight chamber.

11. After about 20 minutes from the time the pump is started, or after a possible leak has been healed, the discharge, as viewed in the dark, will cease for a 2000- or 3000-volt potential. Progressively increase this voltage, always keeping it just high enough to maintain the discharge. When the latter ceases to exist at 4000 to 4500 volts, the pressure is low enough for successful aluminizing. During the discharge period the electron bombardment of the mirror cleans away all adsorbed gas molecules which might prevent the aluminum coat from adhering properly. Although successful evaporations have been carried out after 20 minutes or less of evacuation, it is desirable to wait two hours or more to insure best results.

12. When the vacuum has been judged satisfactory, eliminate the high voltage and impress 5 volts across the filament electrodes *A*, *A*. Be sure to use heavy copper wire to carry the large current. As soon as the circuit is closed, adjust the primary coil rheostat to a point where the heated tungsten quickly melts the aluminum. Then increase the current so that the aluminum can be seen to boil vigorously. When the filament can no longer be seen through the top edge of the mirror disk, break the circuit and pull out the release valve plug.

13. Scrape away the wax around the cylinder base with a wood chisel. Then use the tip of a penknife to cut the wax seal at the cylinder-base plate junction. Jar the cylinder with a sharp slap of the hand and remove. If any difficulty is experienced, the method of increasing the inside pressure, previously described, is useful. The writer much prefers the latter.

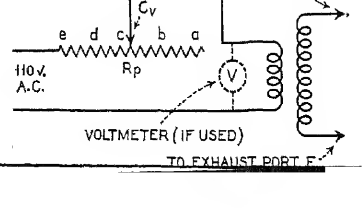
AFTER each run the aluminum coat must be removed from the base plate between the exhaust port and the filament electrodes, otherwise the high-voltage discharge of succeeding runs would pass through this metal film instead of the low pressure gas molecules remaining in the chamber. It is a good plan to shield these areas with strips of glass which are easily removed for cleaning. The filament electrodes may also be protected from excessive coating by glass shields, as shown in Figure 3.

Since successive layers of aluminum on troublesome from the standpoint of vacuum technic, it is desirable to sandpaper the brass surfaces after each set of about five runs. It is impossible to do this to the inside walls of the exhaust port, as dirt and grit would get into the pump. To eliminate this difficulty, place a short piece of glass tubing around the exhaust port, as illustrated in Figures 2 and 3. No deposition of aluminum will occur on the above-mentioned surfaces, with this type of shielding.

WITH regard to the matter of volts in the high-voltage discharge and the amperes of the low-voltage discharge, I have purposely avoided the use of any ammeters or voltmeters in developing the technic and have proved by the results that they are not necessary or desirable.

I knew the approximate discharge voltage and filament current voltage, simply because the transformer ratings were stamped on the instruments themselves. I later measured them with meters to see whether they were about what I thought they were, which proved to be the case. This sounds like an old-fashioned housewife's method of cooking, but was right in line with my avowed purpose to simplify the method and avoid unnecessary complications. In order to improve the situation I will, however, give a more complete set of directions on the matter of knowing when the vacuum is good enough for aluminum evaporation.

In the high-voltage electrical circuit (Figure 5) the letters *a*, *b*, *c*, *d*, and *e* represent a number of possible settings on the high resistance rheostat. If, after the vacuum pump has been operating for 20 minutes, the full voltage (5000 v.) gives a soft grey-blue discharge (the purple or reddish color having faded out), increase the resistance in the rheostat *Rp* until the discharge is just able to persist. Each time it extinguishes, move the variable contactor *Cv* along from *a* to *b* to *c*, etc. At the end of two, three, or four hours the discharge should extinguish with the contactor well over toward *e*. This means that the primary coil is getting the full 110 volts, which in turn means that the filament-*B*-exhaust-port-*F* gap (Figure 2) is getting from 4000 to 5000 volts. (The impressed high voltage is to the reading of the voltmeter across the primary of the transformer as 5000 is to 110.) If the discharge ceases, *when viewed in the dark* at about 4000 volts, the vacuum is O. K. (night time or a dark room is best for studying the character of the high-voltage discharge during the clean-up period. I have often sat watching the final clean-up of a run, and the contemplation of the beauty and soft, soothing character



of the discharge always gives pleasure).

The beginner should make several dummy runs before trying a mirror. Place in the vacuum chamber, for the test runs,small glass vases or other non-porous objects. When cleaned by the method described these trinkets will be more beautiful than silvered ones and will hold their polish indefinitely if handled only with cotton cloth.

I would strongly advise taking written records of each run, just as the mirror maker does when figuring. A set of five or six of these will be a gold mine when future runs are made.

THIS ends Prof. Yeagley's description. From A. F. Hoeflich, 626 16th Ave., San Francisco, Calif., we received, some time ago, the photograph shown in Figure

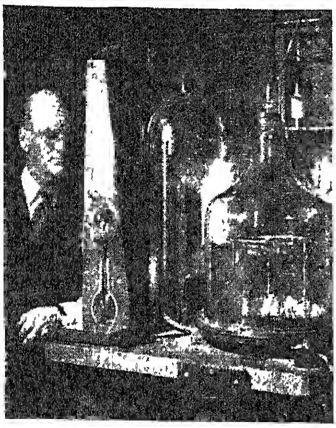


*Figure 6:* W. M. Grant and his rig

6. He writes: "This is photo of W. M. Grant and his aluminizing apparatus which will handle mirrors up to 14". The mercury pump is backed up by a Cenco. All equipment, gages, etc., home-grown. It turns out fine work, as is attested by members of San Francisco Telescope Makers, among whom Grant is leading authority on mirror figuring. A 6" disk is seen suspended on the tripod under the jar. This jar was being pumped to a high vacuum, after which the aluminum around the tungsten coils in the base was flashed. The finish in this demonstration before the club members was a perfectly coated mirror."

IN ATMA, page 296, are photographs of a fine dividing engine made a year or so ago by Vard B. Wallace, one of the original TNs (his picture on page 65 of the 1928 edition of ATM, was taken before his Vard Mechanical Laboratory, Inc., at 2980 East Colorado St., Pasadena, Calif., was organized). He now sends the photograph shown in Figure 7, and writes:

"Here is a picture of our new evaporating outfit. The diffusion pumps are our own design and built in our own shop. The bell jar has a 12" clear inside diameter. We have striven to make this a unit piece of equipment where everything is bolted to the table with nothing at loose ends. The mechanical pump is a Cenco Hyvac and is driven by a 1/6 H. P. motor. The box below is a low-tension transformer for heating the filament. The upper box is a high-tension transformer for testing the quality of the vacuum. The large steel plate on which the bell jar rests is provided with

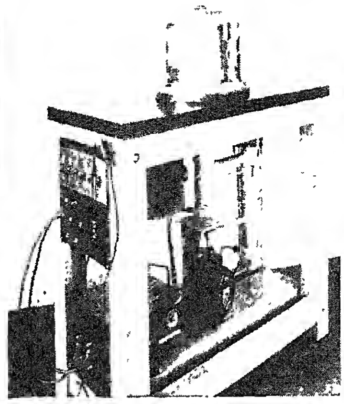


*Figure 7:* Vard Wallace's rig

these electrodes is connected to one of the six holes in the panel at the left end of the table. This arrangement permits setting as many as six filaments at one time, with the possibility of selecting the particular filament that will be fired at will. Practice has proved this arrangement very satisfactory. The push button switch on the end of the long cord permits a close control on the filament current although the operator be

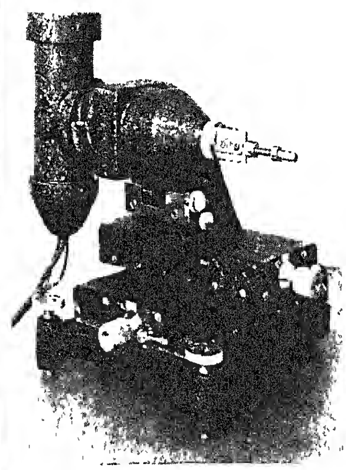


*Figure 8:* Wallace's k-e tester

moving about the jar to find the best position for watching the progress of the evaporating.

"About 17 minutes are required to pump the jar down to a black vacuum. It is possible to clean a mirror, place it under the jar, pump down, fire the coil and admit the air again in about 45 minutes.

"In contrast to the hours I have spent trying to make a good coat with silver, this method is pure delight."

AT our request Wallace also sent in a photograph (Figure 8) and description of his knife-edge testing dingbat. Of such rigs there are now many (this old-fashioned scribe still rooting for the simple hoss-and-buggy kind Ellison recommends). Wallace writes:

"The knife-edge tester was designed after looking at one used by Mr. Dalton at the Mt. Wilson Laboratories in Pasadena. A ribbon filament bulb is housed in the vertical cylinder. Light from this source passes through a pair of condenser lenses and focuses on a pinhole in a piece of foil on the side of a ¼" prism. Just clear of the form of an adjustable slit. This arrangement permits cutting off from either side. The separation between the pinhole and the knife-edge is about ¼". This whole optical system is supported by a rider on a vertical slide that can be adjusted for altitude. A tangent screw permits the system to be rotated a few degrees either side of normal. The vertical slide is supported in a horizontal plane on straight ball races and is controlled by a micrometer screw that reads to thousandths. This, in turn, is carried on a pair of lateral ball tracks and is moved by another micrometer screw.

"This may sound more complicated than it really is. Ball-bearing ways are very little more difficult to make than are the more conventional V ways, and their operation is a delight. The feel of the screws is smooth, yet there is no shake in the whole assembly. Leveling screws support the device at three points. There is some sentiment against equipment of this degree of elaboration, but our experience indicates that it has its place. There is classical precedent for the razor blade on a stick, but the above-described machine gives just as good results, and gives them quicker. And too, it was fun to build it."

Maybe that last sentence most nearly touches bottom. However, fun is fun—so what?—*Ed.*

PROFESSOR Yeagley sent us, a year or so before he sent the above aluminizing article, a description of his own pet knife-edge tester and this is a good time to fish it out and publish it. He described it thus:

"*A*, Figure 9, is a light house containing a 2.5-volt flashlight bulb. On one side is a 1/16" circular opening for use in lining up the mirror under test. Ninety degrees from this opening is a .001" slit, set on a ground glass, for use in the Ronchi and Foucault tests. The slit is made by aluminizing a small disk of glass and making a scratch across one of its diameters.

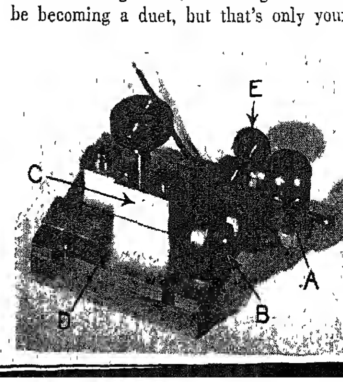
"*B* is an eyepiece containing a Ronchi grating (175 wires per inch, as indicated in ATM for optimum conditions), and a knife-edge parallel to but separated from the grating wires.

"*C* is a rack and pinion assembly for moving the eyepiece longitudinally.

"*D* is a millimeter scale and vernier which estimates accurately .01 cm.

"*E* is a screw adjustment for moving the slit source back and forth sideways, for quick shifting from the grating to the knife-edge."

FIGURE 10 brings us back to Vard Wallace again. (This thing seems to be becoming a duet, but that's only your



scribe's whim of the day. These items have accumulated over quite a long period and are now brought together at one time.) Vard Wallace next speaking:

"A pattern for the base of the circular dividing engine once described in these pages [and in ATMA, page 296.—*Ed.*] was d. sted off, and an iron casting made that proved to be an excellent table for the polishing machine. Around this was built

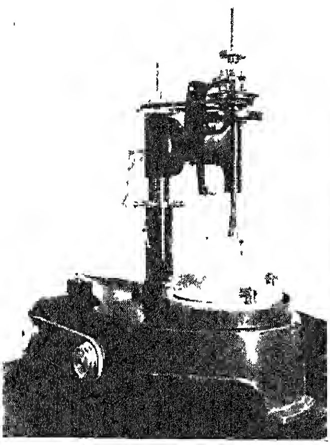


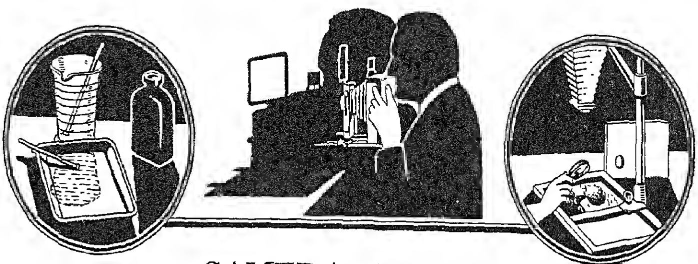
*Figure 10:* Wallace's machine

the rest of the engine. The other castings are of aluminum alloy. Central with the vertical column is a drive shaft on which is mounted a three-step cone pulley. From this runs a V belt to the shell of a clutch on the spindle. The cone of this clutch drives the spindle, and is so adjusted that when the lever control is pulled the spindle is stopped before the driving pin is lifted out of the depression in the polishing tool. This proved a big convenience, as it is not necessary to stop the whole machine each time new abrasive is added. The overarm and spindle can be swung to any position over the work and also can be inclined to the vertical for deep curve work.

"To date, two 6" parabolas, a 10" master sphere and a master flat have been made on this machine and the results have been excellent. The real way to appreciate equipment of this sort is to rub out several parabolas on the corner of a bench by hand. Then the delight of watching the machine work for a single hour will repay all the time and labor it represents." [But when it comes to character building, there is nothing like fighting a mirror 10, 20, 50 or 100 hours, by hand, and sticking to it till you lick it. Other tasks seem easy, after that.—*Ed.*]

NORBIDE is the name of an abrasive offered by the Norton Company. It is boron carbide, $B_4C$, and is the hardest material ever produced by man for commercial uses. It is made at very high temperatures in the electric furnace, from coke and boric acid. It is harder than SiC and the makers state that it will remove stock faster than Crystalon, their name for silicon carbide. And in one pound cans it costs about 18 times as much as silicon carbide!

TWELFTH annual convention of TNs will be held at Stellafane, atop Mt. Porter, near Springfield, Vermont, Saturday afternoon, August 14. Anyone interested is welcome. Many TNs and their telescopes,



# CAMERA ANGLES

**Conducted by JACOB DESCHIN**

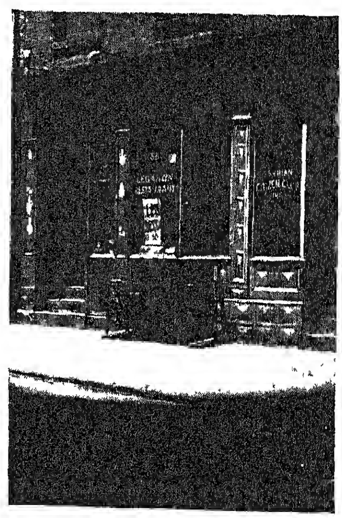
## Covering an Assignment

ONE day you say to yourself: "I think I'll go down by the waterfront and take some pictures," or "I haven't seen a picture of our Main Street in a long while; maybe I can get something good." And so you head for the waterfront or towards Main Street and on the way you try to plan your self-assigned task so that when you get there you will have some idea of what kind of pictures you want to take.

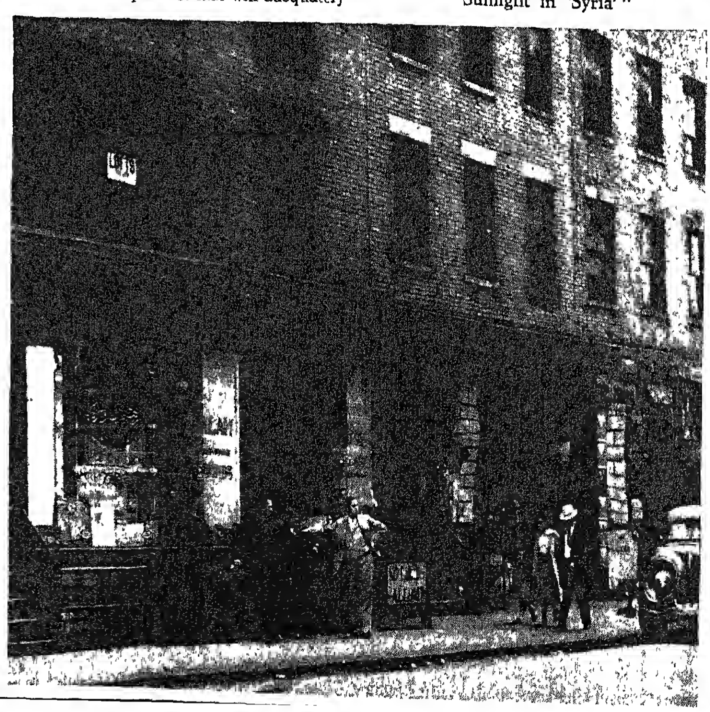
Well, something of the sort is the routine experience of the photographer sent out by a publication to cover a particular assignment, and such was the recent experience of this department when requested by *The Christian Science Monitor* to make some photographs of certain foreign sections in New York City to illustrate an article on "Foreign Quarters."

Like the vague idea of photographing the waterfront or Main Street, an order to take pictures of foreign quarters leaves the responsibility of proper selection of material entirely up to the photographer. Picture-minded, as he is presumed to be, the understanding is that the photographer will know what subjects will best describe the appearance and atmosphere of a particular foreign section and that he will, moreover, have the craftsmanship and imagination to turn his notions into pictures that will adequately illustrate the particular article in question.

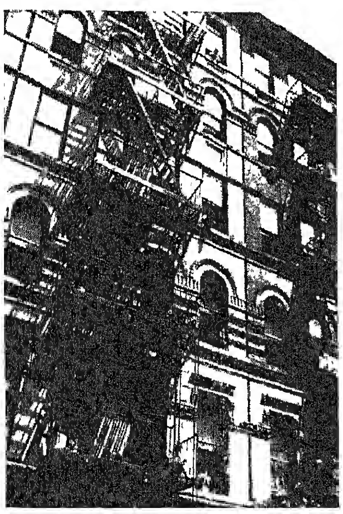
Foreign sections in New York suggested a number of characteristics generally associated with these parts of town. Cobbled streets, fire escapes, the ubiquitous "El," stores with foreign words on their signs, people hanging idly out of windows, men gossiping over coffee cups and newspapers in numerous cafes as they were wont to do in their native lands.



"Sunlight in 'Syria'"



"Italy—With the 'El'"



"The 'Isles' of Greece"

We figured that the job cut out for us in this particular instance was to show the general rather than the particular—street scenes, buildings, the air and feeling of a foreign people adapting their ways to those of a new land yet withal retaining their identity. Syria, Greece, Italy transplanted in spirit to America. If the job called for pictures of the foreign types living in New York, the pictorial approach would have been altogether different. Then we would have tried, by persuasion, where possible, "candidly" where more desirable or convenient, to take portraits and small groups. The portraits would be of men, women, and children who seemed to typify the people of their native land, the small groups would show the people in normal, easy conversation or collective activity. The latter would preferably be of the "candid" picture type. Or the assignment might have covered some such special topic as foreign foods available in New York City. That would have meant concentration on the pushcarts, with their strange fruits and vegetables, invasion of private homes (the latter requiring some diplomacy and tact, of course), and close-up pictures of displays in food store windows and on counters of shops which are picturesque in themselves.

As it was, we had to generalize and that was something else again. Broad views, sunshine, and the cobbled streets, fire escapes, foreign shops and the shadow of the Elevated.

Some of the results are shown, greatly reduced, in the illustrations accompanying this piece.

## Movie Exposure Meter

So small and compact that it fits the palm of the hand, yet so accurate that it gives correct exposure data at a glance for all film speeds and number of frames per second, the Cine Electrodrem, just announced by Photo Utilities, Inc., is justifiably called "the midget master of movie exposure." When using a normal camera speed of 16 frames per second and supersensitive film with a 23-degree Scheiner rating, the reading is direct. You simply point the meter at the object to be photographed and read off without any further adjustment or calculation. By pre-setting an adjustment, the meter may also be read directly for any other movie film used, including Kodachrome, to indicate quickly what exposure to give for speeds from 8 to 96 frames per second and for different lens stops.

## International Salon

An opportunity to test the pictorial and technical value of some of your best photographs is offered in the announcement by the Oval Table Society, Inc., of New York City, of its sponsorship of The International Salon of Photography, to be held November 16 to 30, 1937, at the galleries of the American Fine Arts Society, 215 West 57th Street, New York City.

The entries will be submitted in two

torial Photography, and Section 2 to Technical Photography, the latter comprising the fields of color, news, illustration, commercial, natural history, photomicrographs, aerial, medical and surgical, press, theatrical, geological, metallurgical, and record photography and radiographs. Each entrant is allowed to submit a maximum of four prints in each class. The entry fee is one dollar for each section; the last day for receiving prints, October 23, 1937. The Salon is open to residents of any country.

The society, which, as sponsor of the National Salon of Photography, held in New York City November 1 to 14, 1936, assembled the work of some of the finest photographic talent in this country, now ventures a more ambitious undertaking by reaching out for the best photographs available throughout the world.

The society is "a non-profit organization for the advancement of the art and science of photography." Its president is Pirie MacDonald, Hon. F. R. P. S., and its secretary, Joseph M. Bing, F. R. P. S. Entry forms may be obtained by writing to the Oval Table Society, Inc., 10 West 33rd Street, New York City.

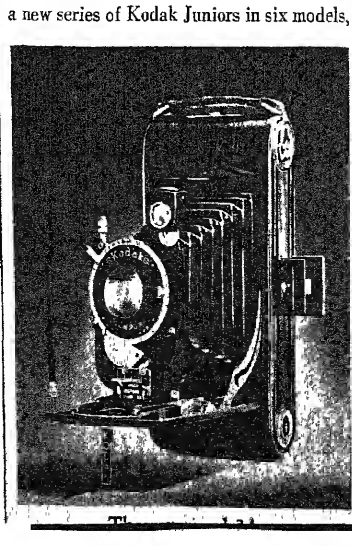
## Special Argus Film Spool

A SPECIAL film spool carrying an 18-exposure film strip and designed for use in the Argus 35-mm camera is announced by Agfa Ansco Corporation. The special daylight-loading spool uses the fast Agfa superpan, selected because of the desired combination of high speed, full color sensitivity, and fine grain.

## New Camera Models

THE old favorite postcard-size 3A Kodak is back in a new dress and with a fast lens. It has just been placed on the market equipped with an F:4.5 lens and a Compur shutter, with built-in self timer. In addition to the eight speeds from 1 second to 1/200 second, plus time and bulb, exposures of intermediate speeds may be made. The new 3A has a rising front, so useful in taking pictures of buildings; diaphragm openings from F:4.5 to F:32; both reflecting waist-level view finder, and metal frame, direct-view eye-level finder; and other features.

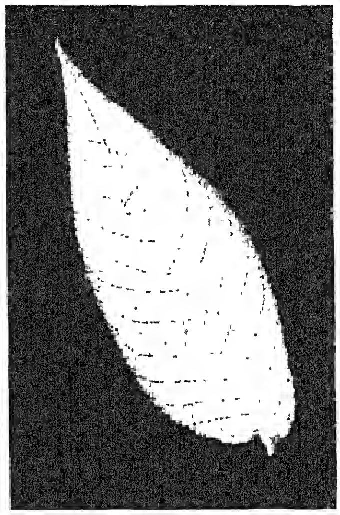
Another Eastman announcement concerns a new series of Kodak Juniors in six models,



designated as Series II. These come in two sizes: Six-16 ($2\frac{1}{2}$ by $4\frac{1}{4}$) and Six-20 ($2\frac{1}{4}$ by $3\frac{1}{4}$), each size with three different lens equipments—single lens, Kodak Bimat, and Kodak Anastigmat F:6.3. The shutters provide speeds ranging from 1/25th to 1/100th second, with time and bulb action. All models carry both waist-level and open frame, direct-view finders.

## LEAF USED AS "NEGATIVE"

A SHORT while ago we had the opportunity of relaying to our readers the description of how the details of leaves could be photographed without a camera.



"Black Walnut"

This information was sent us by Bernard B. Whittier, meteorologist in charge of the Weather Bureau at Fort Wayne, Indiana, who later, complying with our request, had the kindness to lend us some prints of the results. One of these we are happy to reproduce here. The fine detail is ample proof of the success of the method. A sheet of photographic paper and the leaf to be "printed" are placed in contact, the emulsion facing the leaf, and locked in a printing frame. This is done, of course, in a dark-room by the usual printing dark-room light. The exposure is for 1 minute and 10 seconds, more or less, depending on the density of the leaf, with the electric light a short distance away.

## PRINT PRESS

A DEVICE for flattening curled prints up to size 11 by 14 has been introduced by Willoughby's under the name Willo Improved Print Press. "Built to take plenty of abuse with nothing to get out of order," the press will take at one time two dozen 11 by 14 prints or a corresponding number of smaller sizes. Made of wood and metal, the press is said to be proof against warping. It is sold equipped with 18 blotters.

## PRIZE CONTEST

ALWAYS happy to acquaint our readers of a chance to win fame and fortune in photographic prize contests, we here pass on the news that *Sports Afield,* America's oldest monthly outdoor magazine, are conducting a contest which will bring 50 lucky

camera equipment. The contest will continue to November 15 and is divided into two general classes, still and motion pictures, with three classifications in the still group. If you live in North America and are interested, you may secure entry blanks and full particulars by writing to Contest Editor, *Sports Afield*, Phoenix Building, Minneapolis, Minnesota.

## Dark-Room Ventilator

If you are one of those lucky ones who can afford to build yourself a special dark room or have one already, you may be glad to learn of a ventilator especially designed for dark-room use. A dark room can get pretty stuffy at times (ask the man who lives in one!), so this device may prove a godsend to some long-suffering worker. It is called the Ilg Dark-Room Ventilator and was, according to the makers, "designed particularly for the exhausting of foul air, dampness, and odors from dark rooms." The ventilator exhausts 750 cubic feet of air per minute, changing the air in the average dark room about once every two minutes; a scientifically designed baffle keeps out the light.

"The Ilg Dark Room Ventilator," the makers continue, "should be placed in an inner wall near the ceiling, opposite, if possible, from the door to create a circulation of air across the room. By means of a common extension cord and plug, the ventilator can be operated on a light circuit. Current consumption of the fully enclosed self-cooled motor is only 70 watts. No light can enter through the hood, whether ventilator is running or not. Furnished in 110 volts, 25 and 60 cycle, A. C. and D. C."

## "In the Shadows"

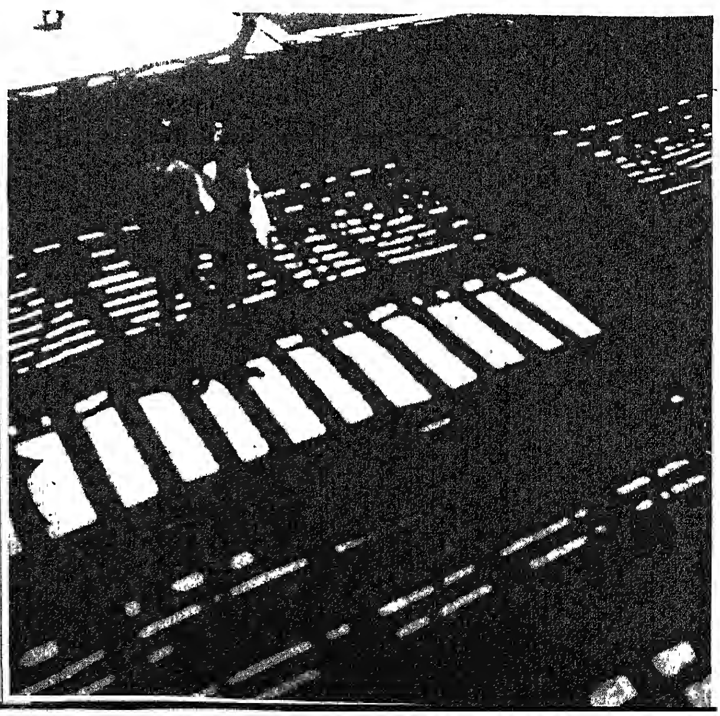
One of the delightful privileges of the photographer on his way toward a definite locale is to be on the alert for any possibility of a picture before he gets there. His mind is attuned to pictures and whether he takes them for a living or for pleasure, he is looking for pictures all the time "In the Shadows" was picked out as one such opportunity as this department saw this shadow pattern from the top of the "El" stairs. Somebody walking across the square was essential to give the picture interest. When a young couple got into the picture, as shown, the time for the exposure was ripe. And here is the result

## Fine Grain

In our June issue we published a review of Mr. Harry Champlin's fine book on the subject of fine grain development, entitled "Champlin on Fine Grain." In another part of the magazine there also appeared the Champlin #15 formula. At that time we should have cautioned our readers that a full knowledge of proper emulsion speed ratings, developing times, and the method for compounding the formula is essential for good results. We recommend that anyone who intends to use this remarkable formula should purchase the book mentioned above, for only from that source can the required full information be obtained.

## What's the Rush?

Take your time. Someone once remarked—we believe it was H. Rossiter Snyder, the well-known photographic journalist—that the difference between the American photographer and the European is that the former will shoot 40 pictures in the time it takes the European to make up his mind to shoot one. As you may surmise, this dexterity of the American photographer is less commendable than the leisurely procedure of his brother across the sea, provided, of course, both photographers understand photographic technique and know what they are doing. Of what avail is it to shoot 40 on the chance of getting only one or two good ones; better to wait, to study the subject from every angle under various lighting



conditions, and finally to make one excellent exposure. It is less wearing; it is a more artistic procedure, for in the process of eliminating this possibility and that, one develops the sense of selection, of "building up" the picture which will stand one in good stead when on occasion it is imperative to make a quick shot and to make that shot a good one. We waste altogether too much film, wear ourselves out too quickly, too much do we flit from this to that and then back again, so eager are we to make as many exposures as possible. It is costly both in money and in physical strength, but more important still is the injury we do ourselves as photographers. No need at all to rush; take your time.

## Finopan Speed Increased

AN increase in emulsion speed to 21 degrees Scheiner in daylight and 19 degrees in Mazda light is announced for Agfa 35-mm Finopan. This, the makers say, has been achieved without the sacrifice of fine grain or Finopan's characteristic wide latitude, balanced contrast, anti-halation protection, and scratch-proof overcoating. The new film may be obtained in 36 exposure cartridges or in 27½- and 55-foot rolls, notched and tongued for easy loading in any camera taking this size film, as well as in 100-foot unnotched rolls.

## Print Folio

A HANDY container for carrying 16 by 20 mounts to the camera club, exhibition, or for general portability, is the Print Folio being distributed by the Fomo Publishing Company. The protection from soiling due to handling or accidental knocking is the chief virtue of this device. From one to 50 full-size 16 by 20 mounted prints may be carried in this folio, conveniently and with full protection. The folio is closed with snaps on one side, is made of durable seal grain artificial leather, and may be washed or cleaned inside and out in case of soiling.

## Glossies From Matt Prints

MATT prints and enlargements may be converted into glossy surfaces by treating them with a waterproof finish now available under the name Marlac. A single coat of this solution, which is practical both for colored and black and white photographs, produces a surface equal to a glossy print, giving depth and richness. The liquid is applied with a high-grade varnish brush and the print then set face-in against a wall. Drying takes place in 12 to 24 hours.

## Lens Cleaning Liquid

OUR chemistry friends will be interested to know that the so-called "lens oil" that is sold for the purpose of cleaning lenses is none other than propyl-iso alcohol, 98-99 percent. And if that means nothing to you or to our other readers, permit us further to divulge the fact that this formula, which is put out by the photographic chemists Mallinckrodt, is practically the same thing as that which is included in the Dallmeyer

## THE SCIENTIFIC AMERICAN DIGEST

*(Continued from page 103)*

A sample of the cloth is measured, laundered and measured again. When the shrinkage is known, the cloth is mechanically crimped that exact amount so that when it is laundered, the straightening out of the crimping almost exactly offsets the shrinking, and the over-all measurements remain unchanged. To so adapt this principle that the "crimping" is taken up by the yarns within the fabric and is imperceptible on casual examination is perhaps not so simple as to be absurd. Some 60 or 70 plants now operate such a process, however, both here and abroad. Whether adaptations of older practice or other shrinking methods maintain or improve their present competitive position or not, it must be recognized that the great and rapid change in trade shrinkage practice, with its many ramifications, is due principally to this one process.—*Industrial Bulletin* of Arthur D. Little, Inc.

### THE TENDER ONES FLOAT

**To separate peas of different qualities, some American canning factories use a brine solution of a density which allows tender peas to float and harder ones to sink.**

### Horse Sense

Tests to measure "engineering horse-sense" in incoming students have been adopted by the Cooper Union Engineering Schools, New York, it was announced recently by Dean George F. Bateman. The tests will be included experimentally in the aptitude examination to be taken in the fall by more than 2000 applicants, less than one seventh of whom can be admitted, owing to physical limitations of the schools.

While the "horse-sense" tests will have no bearing on the success or failure of the candidates this year, the results will be used as a guide for devising future quizzes taking into account inherent fitness for the engineering profession as well as intellectual aptitude.

"In the past we have had too many tragic experiences with boys who came to the school with brilliant records in secondary school work, and who scored among the leaders in the mathematics aptitude test for entrance, only to crack up badly before their first year was completed," declared the Dean.

"Possession of a brilliant mind is not necessarily indicative in itself of engineering promise. A boy may have a quick mind, but lack the mechanical flair and the ability to visualize engineering problems that an engineer must have. Again, the brilliant boy frequently lacks the plodding sort of stamina that is essential to successful work in a good technical school.

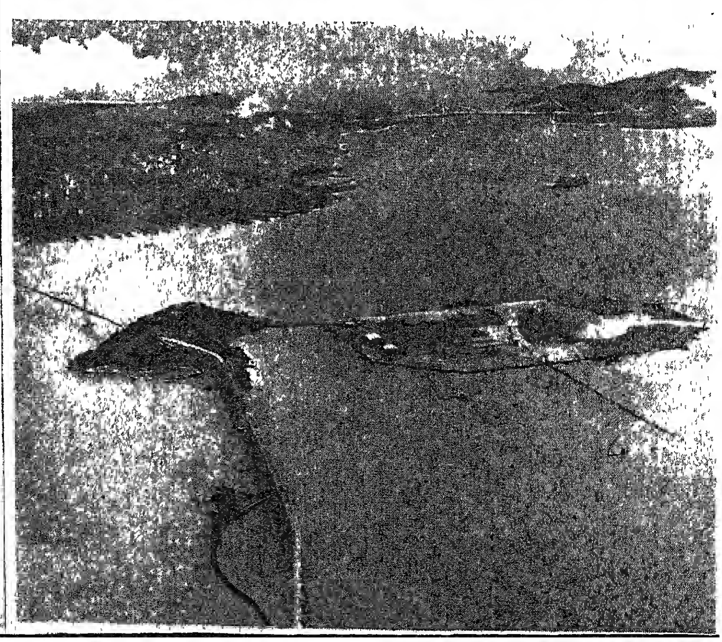
"Balance, above all things, is required of the good engineer, and balance is what the brilliant boy often lacks. It is not enough to be able to arrive swiftly on paper at a solution to a problem. The engineer does not build on paper. The solutions to his problems must work as he visualizes they will work.

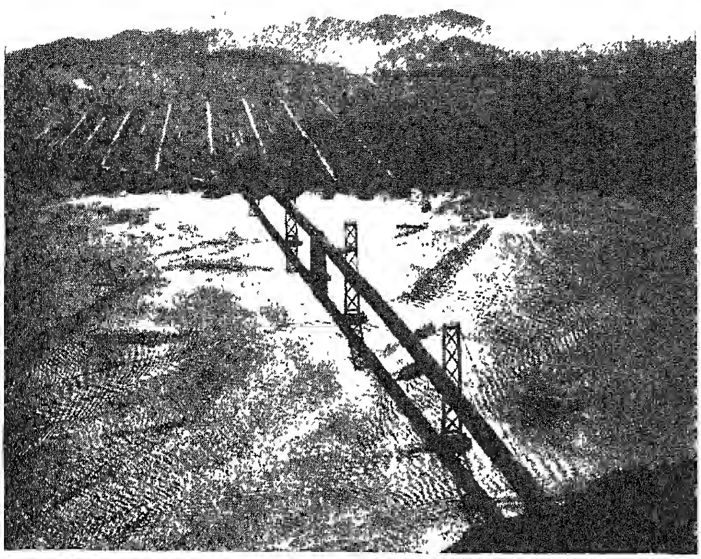
"It is this balance, this practical sense of engineering, whatever it might be called, that we want our admissions to have. Our academic casualty rate is too high, despite the unusual selectivity we exercise. Approximately one applicant in seven can be admitted to the Day School of Engineering, and of those admitted, only 65 percent, and in some classes as few as 45 percent, can be expected to graduate."

### New Island Causes New Currents

There have always been strong tidal currents in San Francisco Bay, greatest landlocked harbor in the world. Ferry boat pilots, shuttling back and forth day and night, have learned them and learned to use them; port pilots, bringing in the liners and the tramps, know them too.

But a new island has loomed up in this harbor—the largest island ever built by man, 400 acres dredged from the bay bot-





The San Francisco-Oakland Bay Bridge is another cause of current changes

tom by United States Army Engineers to serve as the site of the Golden Gate International Exposition in 1939 and later as an airport, municipal and trans-Pacific.

It is conceded that this island, more than a mile long and 3400 feet wide, has changed the currents of San Francisco Bay, but even veteran San Francisco Bay pilots and tugboat captains disagree on the extent of these changes. Some describe them in strong terms, others are not much more than aware of them.

To determine exactly the extent and effect of these "Treasure Island" current revisions, the United States Coast and Geodetic Survey is arranging for observations with the co-operation of the Engineers. Results will be incorporated in current tables and charts covering the area, as information needed by pilots.

Several days of continuous half-hourly measurements of velocity and direction of current will be taken at each of three selected stations near the exposition site. An anchored vessel, equipped with especially devised instruments, will be employed.

The great San Francisco-Oakland Bay Bridge and the Golden Gate Bridge, largest in the world in their classes, also have had their influence on tidal set, for their huge piers rise directly from ferry lanes or harbor entrance. In connection with the same survey it is planned to secure, if possible, a series of current observations at the bridge sites themselves.

From such observations, precise values for velocities and directions of new currents may at any time be predicted for the use of navigators, engineers, or other technically interested persons. Pilots are awaiting publication of the new data with considerable interest.

Are the new currents beneficial or detrimental? That is the question, the answer to which will be engraved upon the fine-lined sheets in a thousand Pacific chart-rooms.

## Silver Ages Brandies

TRACES of silver added electrically to brandies have been found to effect changes similar to those produced by aging, rather than in months or years. The amount of silver added is too small to be detected by ordinary methods of analysis and chemical tests show insignificant changes in the composition of the brandy itself. However, a change in flavor can be produced within five to seven days by the treatment. No ruling on whether such treatment will be permitted under the food and drug laws has yet been made.—*D. H. K.*

**BROMINE**

**THE plant at Kure Beach, North Carolina, for the recovery of bromine from the sea was enlarged recently so that now 137,000 gallons of sea water are pumped through per minute. This is a volume great enough (were it fresh water) to supply the drinking water requirements of two cities the size of New York, allowing each inhabitant 10 gallons daily.**

## Electric Water Heater at Boulder Dam

WHAT is, in effect, the largest electric water heater ever devised by man is in use at Boulder Dam in connection with the testing of the huge 115,000-horsepower generators now being put into operation there by the Bureau of Reclamation, Department of Interior.

In principle, this heater, which is really a water rheostat of high capacity, is comparable with the small household heater used to warm junior's milk bottle in the wee hours of the morning. But, instead of using a mere 110 volts as does the average household heater, the Boulder Dam unit absorbs current potentials up to 18,600 volts.

The purpose of the rheostat is to absorb the current generated during tests of the generators. The rheostat consists of three poles to conduct the current of the three-phase cycle into the water of the power-house tailrace which furnishes the resistance required to absorb it. The farther the poles

set up, thus affording the engineers the opportunity for observing the behavior of the generating unit under all conditions.

In order to accomplish this purpose with precision a chemical analysis of the water was made to determine its conducting properties and the resistance it would have under varying conditions.

Fish swimming into the field of the rheostat are apparently electrocuted and float to the surface, but once the current is turned off or they float out of the charged field, they regain life and swim away quite unaffected by the experience of having tangled with the electric energy generated by the largest power plant in the world.

## Mass Production Precision Weighing

OF all systems of weighing, the most efficient is, of course, the balance, a system in which the weighed material is evenly balanced by weights on the other end of a pivoted arm. This principle has been applied to a compact precision instrument which has been developed for use in predetermined precision weighing. A product of The Exact Weight Scale Company, this instrument does not have the usual tower, is completely self-contained in a dust-proof cabinet, and indicates exact weight by means of a light beam, so that there is no possibility of parallax. This light beam and the shadow it throws give the name Shadowgraph.

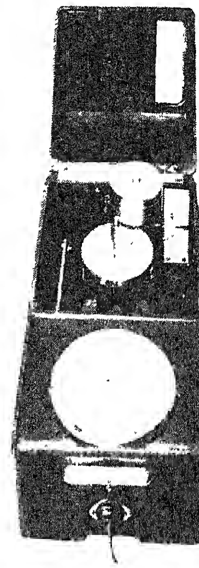
Simply stated, the Shadowgraph is a weighing unit composed of an even balance scale mounted on a common base plate. Indication is derived from a needle mounted on the load-receiving end of the scale. This needle intercepts a single light beam, thus projecting a pointed shadow onto a reading dial, graduated either to certain values or for center indication only. Weighing is done against actual sealed weights, deposited on the weight platter inside the housing. For delicate weights, precision weighing is possible because of the long indicator travel; a ⅛-inch lever movement produces an indicator travel of 4 inches. Our illustrations show the machine in closed position, and open so that the stacked weights, weight rack, weight platter, and part of the beam are visible.

The Shadowgraph is built for either alternating or direct current operation. Parts are mounted in rubber to eliminate noise

A light beam is used to indicate

and jolting; bearings are agate; pivots are hardened tool steel; and the commodity container is a six-inch round plate. The scale capacity is either five pounds avoirdupois, or 2500 grams metric, and the beam is graduated to read one pound by half-ounce graduations, or 500 grams by five gram graduations.

For predetermined weighing in mass production industries the Shadowgraph has al-



Interior of the balance, showing commodity container (front), weight platter, stacked weights, and the light-beam indicator (right)

ready found wide use. It is particularly adaptable to such operations as the balancing and selecting of automobile connecting rods, for small parts selection, chemical packaging, and so on. It can be used by glass manufacturers, instrument makers, food packers, and all types of general industrial plants where selective operations can be more efficiently met by weight.

**CHEMICALS**

**EVERYONE knows that he must eat proteins and carbohydrates but few know that there are ten chemicals with tongue-twisting names which must be present in the diet if we are to prevent nutritive failure. They are: lysine, tryptophane, histidine, phenylalanine, leucine, isoleucine, methionine, valine, threonine, and arginine.**

## Amorphophallus Titanum Blooms

THE world's largest flower, seen for the first time in America, bloomed on June 8 at the New York Botanical Garden. Because it is such a rarity, as well as a monstrous curiosity, crowds were attracted to the Garden for the event. Previous specimens which have been brought into flower in cultivation (one at Kew Gardens, England, in 1889 and another in 1926) have grown at the rate of three or four inches a day, but the New York Botanical Garden's

*Amorphophallus Titanum* in bloom

from the time the flower bud first appeared above the soil. This *Amorphophallus Titanum* flower was the largest one on record in cultivation, being 8½ feet tall and four feet in diameter. It is related to the calla-lily and jack-in-the-pulpit.

A long, thick, greenish-yellow column, called the spadix, stood erect above the stem. It protruded above the pale green ruffled and fluted spathe, which opened and spread to a diameter of about four feet. Its turned-back edges wore a lining of rich chocolate-brown.

Within this protecting spathe, massed in close rows around the columnar spadix, innumerable small flowers were borne, the males in one group and the females, like carmine-red cherries, in another group near the base. The spadix turned butter-yellow when the inflorescence was mature, and when the spathe began to open, a nauseous odor, worse than decaying fish, was emitted. On the tropical mountain slopes of Sumatra, where the plant is native, carrion flies which pollinate the flowers are attracted by the smell.

The New York Botanical Garden imported the tuber from which the flower has sprung, directly from Sumatra in 1932. It then weighed sixty pounds. Now it has increased to 100, but is expected to lose about ten pounds as a result of the energy used up in producing the inflorescence.

The flower lasted only a few hours after opening. While the specimen which flowered at Kew in 1926 was in good shape for two days after opening, the previous flower crumpled and toppled to the ground less than half a day after opening.

## Plastic Lenses

MOLDING has been found to be a satisfactory method of making optical lenses from the very clear acryloid resins. By using molds of extreme precision and carrying out the molding operation with the greatest care, it has been possible to make satisfactory lenses for cameras, telescopes, and spectacles, as well as other optical instruments, which do not require the tedious grinding and polishing neces-

lenses in England and Germany have shown the new technique to be satisfactory for most purposes. The extraordinary optical quality of the resins themselves and the great accuracy with which they can be molded are the basis for this new development. For spectacles, lack of brittleness is an important characteristic as it reduces the possibility of breakage of lenses.—*D. H. K.*

## Air Conditioning in 1852

EXACTLY 85 years ago on May 15, Scientific American published an item which gave essentially the features of present-day air conditioning. It is most interesting to note that despite this comment, which is reprinted in full below, air conditioning as such is only about 25 years old. The item follows:

**Cooling Air in Hot Climates**

In the East Indies, and all tropical climates, Europeans suffer severely with the intense heat. To keep apartments bearable at all, fans are kept going continually, and wet mats are hung in the windows, from which the moisture evaporates and leaves the air somewhat cool. This plan, however, has been found very unhealthy, because rarefied air containing moisture has too little oxygen in it for the healthy aotion of the lungs. A Dr. Piazza Smith has recently published a pamphlet in England, upon a superior plan for supplying rooms in tropical countries with dry cold air, freed from moisture. His plan is to compress the air by mechanical means, then rob it, while so compressed, of its heat, and when cool, allow it to expand into the rooms, for which the apparatus is intended. If he can take air at 90° of temperature, compress it, and extract 30° of heat, he will have air at 60° to enter a room, which will thus be kept at a pleasant temperature. His cooler is to be formed of a pipe under water, and a pump is to force the air in at one end of it (the pipe) and out at the other, which is to have a weighted valve placed upon it. This plan appears to us simple and rational. If a copper pipe were laid in a stream of cool running water for some distance, and hot air forced through it into apartments, there can be no doubt but it (the air) would be rendered cool and healthy. A gentleman of wealth might employ such means to cool his house in a hot climate. A pipe, like the worm of a *still*, if placed in a deep well, would also answer the purpose of an air cooler, but in every case it would be well to have a valve on the exit end of the pipe. An iron pipe would answer as well as a copper one, only it is not such a good conductor of heat and cold as copper.

## Wealth Thrown Back Into the Sea

POTENTIAL wealth valued at 96,379,460 dollars at current prices was contained in 158,735,000,000 pounds of ocean water pumped through the bromine plant of the Ethyl-Dow Chemical Company at Kure Beach, near Wilmington, North Carolina, during the past 12 months.

Of these riches from "nature's greatest storehouse of raw materials," only a small part was recovered in the form of several thousand tons of bromine to find its way

mobiles and tractors as an important component of Ethyl fluid. The remainder, including 42,000 dollars' worth of gold, 29,300 dollars' worth of silver, enough magnesium to build 100,000 modern airplanes, and a quantity of common salt sufficient to lay a paving 26 feet wide and a foot thick from New York to Washington, together with millions of dollars worth of mineral salts and other basic substances, flowed back into the sea via the Cape Fear River.

Two giant electric driven centrifugal pumps lifted a square mile of seawater 89 feet deep into the plant during the year. Possible by-products, which science has as yet made no serious attempt to extract economically from the ocean, occurred in the water as follows:

Sodium chloride, or common salt, 2,140,000 tons, worth 33,200,000 dollars at present market prices. Epsom salts, 542,500 tons, worth 18,050,000 dollars, enough to give every man, woman, and child in the United States nine pounds. Calcium chloride, 118,000 tons. Potassium chloride, 61,000 tons. Magnesium, 48,000 tons, worth 33,600,000 dollars, enough for 1,500,000,000 photographers' flash lights, 100,000 modern airplanes, or 250,000 stratosphere gondolas. Aluminum, 139 tons. Strontium carbonate, 160 tons. Iron, 145 tons. Copper, 9.2 tons. More than three tons of iodine. Enough gold to make a five inch cube valued at 42,000 dollars. Silver to make a ball twenty-five inches in diameter, worth 29,300 dollars.

In addition to the substances listed, practically every known material is dissolved to a greater or less degree in ocean water, according to Ethyl-Dow chemists. Besides providing an inexhaustible source of bromine, extraction of which constitutes science's first major step in recovering chemical wealth from the sea, the ocean forms the greatest storehouse of raw materials on the globe, it is said.

## Tuberculosis Among College Men and Women

TUBERCULOSIS is more prevalent among college men than among college women. It occurs more frequently among college students in the east and far west than in the middle west.

Dr. Esmond R. Long and Florence D. Seibert of the Henry Phipps Institute, University of Pennsylvania, report the results of the tuberculin test on 18,744 college freshmen in 1935-36 in the *Journal of the American Medical Association.*

Accurately completed tuberculin tests were given to new entrants at 20 colleges. From 40 to 60 percent of students showed tuberculous infection in the eastern and far western colleges, and from 20 to 30 percent showed infection in the central states. Since the majority of students were residents of the general region of their college, Dr. Long and Miss Seibert believe they reflect the incidence of tuberculous infection in the population of these regions.

Denser populations in the east, imposing more frequent contact and in the long run more exposure, are thought to account for the high rate in the east. In rural Idaho almost no students react to tuberculin, while in the mining districts of southern Idaho there are many positive reactors.—*Science Service.*

University physicians have noted a much higher incidence of tuberculosis in college students when they systematically tested them all, than are noted in places where the student is left to come in for examination only when he becomes aware of active symptoms. This, in fact, is the chief argument in favor of systematic hunts for incipient cases, both in colleges and high schools; for an individual may go far into serious involvement with tuberculosis without ever suspecting he has it. The test is very simple: a drop of tuberculin is injected, and if no reddened area develops around the spot, tuberculosis is not indicated.—*The Editor.*

### ANTIMONY

SEVENTY percent of the world's antimony comes from China. Since January, 1937, the supply of that metal has been under Chinese Government control.

## Relic-Grabbing Attacked by International Congress

AN international mass attack on relic-grabbing, endangering the world's buried history, is being pushed by archeologists.

The recent international congress of archeologists at Cairo, Egypt, strongly urged standardized laws throughout the world to curb "pot hunting," American delegate Dr. Frank H. H. Roberts, Jr., of the Smithsonian Institution, stated on his return from the congress.

Most European countries have severe laws against so-called pot hunters, who wreck archeological ruins and burials merely to gather curios. The United States has a particularly hard task to keep irresponsible diggers from despoiling Indian sites, Dr. Roberts pointed out, because each of the 48 states handles the problem in its own way. —*Science Service.*

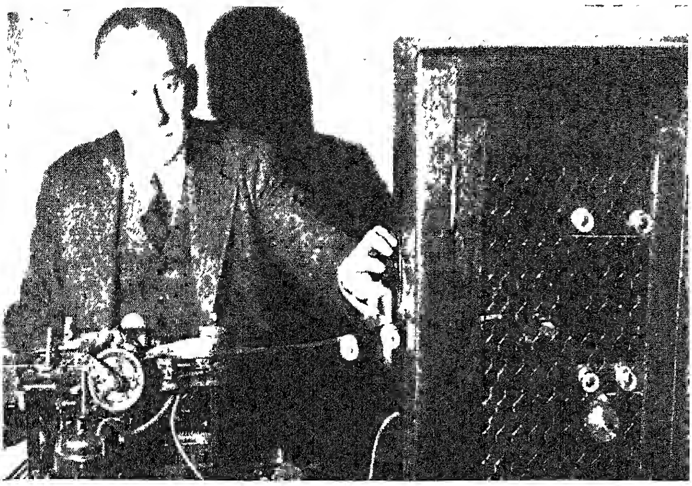
## Nonflammable Transformer Oils

IMPROVED life and performance of liquid insulating materials in electrical equipment have been realized by the substitution of nonflammable synthetic materials for the mineral oils now generally used. One of the faults of petroleum oils as insulating materials in electrical equipment is their tendency to oxidize and form sludge in service. By using the more stable chlorinated derivatives of diphenyl, diphenyl oxide, diphenyl ketone, and diphenyl methane, not only are sludge formation and dielectric deterioration avoided, but fire and explosion hazards are eliminated. The dielectric characteristics of the new compounds are particularly favorable.—*D. H. K.*

## No Secret to Pyramids

NO use trying to read mystic secrets from Egypt's pyramids by numerology or any other theories, because the pyramids have no secret, according to the emphatic view of a German Egyptologist, Dr. Georg Steindorff, professor emeritus of Egyptology, University of Leipzig.

Egypt's pyramids were simply royal tombs, and the evolution of the pyramid form from flat-topped tombs is well under-



*Above:* Special cellophane tape being fed into the television news transmitter. *Below:* The shadow-box of the receiver, showing how bulletins are reproduced


notions persist that the pyramids had mathematical or astronomical significance. The most popular theory, the German Egyptologist said, assumes that the Egyptians knew the relation of the circumference of a circle to its diameter, that is, the value of $\pi$. However, they had no such knowledge in the pyramid era.—*Science Service.*

## Electrical Behavior of Paints

PIGMENT particles in paint vehicles assume electrical characteristics which depend upon the nature of the vehicle. Recent studies of what happens when paints are placed in an electrostatic field are expected to lead to important improvements in methods of compounding ready mixed paints. It has been found, for example, that a zinc oxide pigment may be attracted to either of the two poles of an electric field or may be dispersed between them, depending upon the character of the oil in which it is ground. Aging also changes the electrostatic response of pigment particles.—*D. H. K.*

## News by Television

NO super-power tubes, but an automobile headlight bulb and a whirling reflector-lens disk are the heart of a new television receiver, developed by William Hoyt Peck to show moving news bulletins on a 6 by 30 inch screen, large enough and bright enough to be readable at 150 feet or more.

The transmitter utilizes a specially constructed typewriter, which prints ⅝-inch characters on a strip of cellophane tape. turn unnecessary, and holds about a half-mile of tape at one "loading."

The tape goes from the typewriter platen directly into a transmitter cabinet about the size of a four-drawer file. There it is scanned by a beam of light projected onto it from a reflecting-lens disk optically interposed between it and an automobile headlight bulb. The light then passes through the tape to strike a photo-electric cell connected to a local pre-amplifier. The signal thus produced is further amplified and transmitted.

At the receiver, the signal is amplified and fed into a Peck light-modulator tube, which modulates the beam from another headlight bulb as it passes through the tube to strike a receiver reflecting-lens disk, from which it is projected onto a two and one half foot screen at the end of a foot-deep shadow box about six feet from the floor.

## Ice Cream Packed in Dry Ice—Wool Cleaning Process

BECAUSE Robert M. Greenleaf, Los Angeles mechanic, took his family on a picnic some five years ago, the wool industry now has a new method of cleaning wool—the "frosted" process of wool cleaning. Wool cleaned by this process is whiter, fluffier, and stronger, and dyes deeper and brighter than wool cleaned by the more expensive conventional soap, water, and picking processes. Already, reports *Science Service*, over a million pounds of wool have been cleaned by "frosting."

In this method, burs, thistles, and vegetable matter which become entangled in the wool as the sheep browses, are literally frozen out of the wool by passing it on conveyers through a large "ice box" in which the temperature is kept from 30 to 50 degrees, Fahrenheit, below zero. Grease also is removed.

The "ice box" is a room 40 feet long, 12 feet wide, and 12 feet high with walls, ceiling, and floor made of nine-inch thick cork.

The low temperature freezes solid the burs and grease on the wool. Strangely, in such frozen state, their hold on the wool is loosened so that when the "frosted" wool is beaten or shaken, the dirt and impurities readily drop away. The whole process takes but a few minutes. About 1500 pounds

is less than four tenths of a cent per pound.

At the time Mr. Greenleaf went picnicking, he was trying to design a machine that would get the spiral burs, so common in California wool, out of the raw wool directly.

At the picnic, a woolen blanket was spread on the grass for a table cloth. There was ice cream for dessert, packed in dry ice. In unpacking the cream, Mr. Greenleaf threw the dry ice on the blanket. That was a lucky pitch, for later when picking up the blanket preparatory to returning home, he noticed that the vegetable matter on the ground was frozen to the blanket and when he shook it, the sticks and leaves dropped away like icicles. Instantly the idea of removing burs from wool by freezing entered his mind.

He dashed home to try it; packed dirty, raw wool in dry ice. It worked. Later a wool manufacturer became interested, as did certain engineers. A corner in an ice-making plant was rented to carry out large-scale research.

Samples of frosted wool were sent to eastern wool manufacturers. Soon the Lowell Textile Institute of Lowell, Massachusetts, set out to perfect the frosting process on a commercial scale. Today one of the largest worsted wool mills in that state is using the process.

## Transfusions of Own Blood Aid Mothers

Blood sucked mechanically from the mother's body and injected back into her own veins has helped 38 women recover from child-bearing that was dangerously complicated by development of the baby outside of the womb, Dr. Arthur J. Wallingford of Albany reported to a recent meeting of the Medical Society of the State of New York.

Dr. Wallingford hit upon the idea of this auto-transfusion when he noticed, during the operation to save the patient's life, that large amounts of blood had escaped from the veins into the peritoneal cavity in these mothers, and that the women were in immediate need of more blood in their veins and arteries.

The advantages of the auto-transfusion, which is performed before the patient leaves the operating room, are that there is no need for another donor and that the blood is immediately available when it is urgently needed.

No untoward reactions have occurred with this procedure.—*Science Service.*

## Light Without Heat

Production of light without wasting energy as heat has long been a problem to which physics has devoted itself. Although the ideal is still impossible to attain for commercial purposes, there are many chemical reactions which release energy in the form of light instead of heat. It is possible with relatively little equipment to demonstrate this striking phenomenon. In a recent issue of the *Journal of Chemical Education,* Evans W. Cottman gives directions for doing this. His method depends on the oxidation of lophine in solution and his directions may be summarized as follows: crude lophine is prepared by shaking together 25 cc of benzaldehyde with 100 cc of strong ammonia water and allowing the mixture to stand for three days. A white cake of hydro-benzamide forms. This is broken up and washed with water, then with alcohol and heated gradually in an evaporating dish with constant stirring until it forms a dark brown liquid. When cool, this crude lophine forms a glassy solid. To produce chemi-luminescence four solutions are prepared:

A. Two grams of lophine are dissolved in 100 cc of alcohol (either ethyl or methyl alcohol may be used).

B. Hydrogen peroxide solution is made by mixing 10 cc of ordinary commercial 3 percent hydrogen peroxide with 90 cc of ethyl or methyl alcohol.

C. Alcoholic potash solution is made by dissolving 5 grams of caustic potash in 75 cc of water and adding 25 cc of ethyl alcohol.

D. Sodium hypochlorite solution is made by mixing 10 cc of "chlorox" (commercial bleaching solution) with 90 cc of water.

For the demonstration a mixture is made of 10 cc of solution A with 25 cc of solution B and 20 cc of solution C. In the dark, this mixture is poured into 25 cc of solution D to produce a yellow luminescence. The light produced by this reaction in many ways resembles that of the familiar lightning bug.—*D. H. K.*

## Simple Sextant for Amateurs

Nearly everybody has seen pictures of sailors "shooting the sun" with a sextant. Few persons, however, have had the fun of using a sextant themselves and seeing just how it works. A simple, inexpensive sextant enables young boat-owners, aviation enthusiasts, steamship passengers, and others interested in navigation to expand their hobby to new horizons.

First invented about 1730 simultaneously by Thomas Godfrey of Philadelphia and Captain Hadley of the British navy, the sextant has always been a high-priced instrument, because of the difficulty in precise assembly of the parts. With the use of recently developed production methods, the mirror holders and other parts requiring precision in this low-priced instrument are cast to within .001 inch.

Close-up of the simple sextant

The simple sextant in use

An engraved scale is graduated to ½ degree and a vernier attached makes possible readings to 1/20th degree. Green celluloid sun-shades are used as a safeguard when shooting the sun. The sighting device has a simple form of artificial horizon consisting of a bubble level, so that persons indoors or inland may use the instrument for demonstration and instruction purposes.

The sighting tube does not have a telescope but is a modern adaptation of earlier sextants which had a flat perforated disc for a sight.

Anybody can readily measure angles in a horizontal or vertical plane by pointing toward one of two distant objects which can be seen through the clear glass opposite the sighting tube. By adjusting the movable arm, the image of the second object is reflected from the rotating mirror into the mirrored part of the fixed glass opposite the sighting tube. When the first object and the image of the second object are in line with each other, the reading is then taken on the graduated scale.

### STEEL

A BILLION tons of steel in all forms was in use during the past year in this country. This total represents an average of 17,800 pounds in use for every man, woman, and child.

## Hippocampus—Odd Fish

PERHAPS in no other animal have been packed so many anomalies as in the little hippocampus, popularly known as the seahorse, a systematic study of which has just been completed at the Smithsonian Institution by Mr. Isaac Ginsburg of the United States Bureau of Fisheries.

These fantastic animals are almost world-wide in their distribution through ocean waters where there are growths of sea vegetation. They have provided the models for some of the nightmare monsters of the human imagination. Actually they are small, feeble, almost defenseless creatures.

The head is unquestionably similar to that of a miniature horse in general outline.

Fishes have no necks, and hippocampus is no exception. What looks like a neck is the front part of its abdomen, considerably contracted.

The body of the animal is covered with a jointed, chitinous shell, like that of many insects. This feature left early naturalists in doubt as to whether it actually was a fish or some sort of monstrous water bug. It is, of course, a true fish, with no insect affiliations.

This hard shell makes it a feeble, inefficient swimmer. It can bend its body only sideways. It is able to swim at all only because of a large air bladder so delicately adjusted to the specific gravity of the animal that if a gas bubble the size of a pin-head is let out by a puncture the seahorse sinks to the bottom. There it can only move clumsily until the wound is healed.

Since it is so poor a swimmer, the hippocampus must have other means of adjustment to its salt-water environment. This is afforded by a prehensive tail which it can wrap around the stems of water plants. This kind of tail is found among a few mammals, notably the smaller monkeys. So far as known, no other fish has anything of the sort. The animal is most frequently observed in a state of rest, its tail wrapped around a plant and its body standing nearly erect in the water.

Its food consists of tiny crustaceans and other sea organisms, usually minute. Because of its poor powers of locomotion, it must wait for those that come within reach of its jaws, which work with lightning-like speed, or for those which will accommodatingly wait for it to come and get them.

Hippocampus can move its eyes independently of each other, thus looking backward and forward at the same time.

Probably the greatest anomaly of the hippocampus family is its way of reproducing the species. The male actually gives birth to living young. The process, so far as is known, is unduplicated in nature. Unfertilized eggs are laid by the female. She places them, a few at a time, into a pouch-like organ on the under side of the male's body. In some manner still unknown to biologists they are fertilized in the transfer.

Within this pouch, the eggs are incubated and remain for some days after they are hatched. Then the living young, fully equipped to take care of themselves, are expelled into the water. So far as ever has been observed, there is no further parental interest in them. This male pouch might be considered as filling the double function of the womb of a placental mammal and the pouch of a marsupial like the kangaroo.

The seahorse also has the distinction of being one of the species of fish that "talk." It makes almost inaudible, snapping noises with its jaws which seem to serve as a means of communication.

## Insecticide Improvement

LIMITATIONS on the use of insecticides containing arsenic and lead on edible farm products have encouraged and stimulated the search for materials for protecting crops against insects which will not leave toxic residues. More than one thousand compounds believed to be useful for this purpose have been carefully examined in

ture, but only four of those offered show apparent value at present In a research report by Lee A. Strong, Chief of the Bureau of Entomology and Plant Quarantine, the four now offering the best possibilities are noted as phenothiazone, nicotine in new forms, pyrethrum, and rotenone. In addition, certain compounds of sodium with aluminum and fluorine have shown promise of controlling the coddling moth in relatively dry areas, but, because of the toxic nature of fluorine compounds to man, this type of insecticide is looked upon with less favor.

Phenothiazone, a compound made from diphenylamine and sulfur, has been found very effective against insects but unfortunately it is highly irritating to the skin of a person applying it as ordinarily used. Efforts are being made to find improved methods of application which will avoid this difficulty.

Nicotine extracted from tobacco scrap can be made to adhere to foliage only with difficulty. Combinations of nicotine with bentonite, a colloidal clay, and with peat, as well as oil emulsions of nicotine sulfate, largely overcome this difficulty.

Improvements have been made in the extraction of rotenone from the plants in which it occurs and these are expected to increase the usefulness of this valuable material.

Efforts to synthesize the active principle of pyrethrum have so far been unsuccessful. Despite these advances, the search for the ideal insecticide continues and a vast amount of research is in progress both in government and other laboratories.—*D. H. K.*

## Clarifying Grape Juice

ARGOLS, the crude cream of tartar which occurs in grape juice and which continues to deposit in the bottle, has been the cause of one of the serious troubles of manufacturers of grape juice and wine. At the New York State Agricultural Experiment Station tests have shown that grape juice can be clarified permanently by freezing. The procedure is to place the juice in a sharp-freezer at 0 degree, Fahrenheit, for a length of time depending upon the container. Glass carboys require four days and barrels seven in the sharp-freezer. For thawing, the containers are moved to a room at 45 degrees, Fahrenheit, equipped with ample air circulation and left until all ice has melted. By siphoning off the clear juice from the undisturbed containers it can be bottled and pasteurized without fear of clouding.—*D. H. K.*

## Lake Mead Does Not Alter Weather

HAS Lake Mead, more than 100 miles long and the largest man-made body of water in the world, exerted any influence on the weather and climate of America's driest desert, in the heart of which it was created by construction of Boulder Dam in the Colorado River? This question, about which there has been much speculation, now can be answered: "Emphatically, no."

"Lake Mead was not expected to influence the weather of the Southwest," John C. Page, Acting Commissioner of the Bureau of Reclamation, said recently. "It has not done so and it will not."

Sanitary and easy to use are perforated aluminum tea "balls" that come packed ready for use and are discarded after the tea is made

when unauthoritative statements were circulated that perceptible changes in the climate and weather were resulting as Lake Mead grew behind Boulder Dam. The Bureau of Reclamation had calculated in advance the rate of evaporation from Lake Mead which could be expected. These calculations indicated that insufficient moisture would be lost to cause a noticeable alteration in weather conditions.

J. Cecil Alter, meteorologist for the Weather Bureau at Salt Lake City, summed up the evidence obtained with this observation:

"By comparison, the water in a pitcher on a speaker's stand is about as effective in air-conditioning an auditorium as Lake Mead is in modifying the climate."

## Tree Growth is a Trick Question

WHERE and how does the growth of a tree occur? One of the trick questions of Professor Quizz is that if you drive a nail in a tree when the tree is five feet in height will the nail in the tree be any higher when the tree is 100 feet tall? After the first year's growth on a tree occurs, that portion of the tree never grows in length. The tips of the branches put on new shoots each season, and by the end of that year's growth that part of the tree is never extended in height. It does, however, grow larger around with the passing of the seasons.

The growth of a tree occurs almost entirely just beneath the bark. During the growing season a row of cells called the cambium layer multiplies and adds a thin layer to the outside of the wood of the trunk and a still thinner one to the inside of the bark. This new growth has been compared with a glove pulled on over the old growth.

So, a nail driven in a tree four feet above the ground will never be any farther above the ground or any closer to it as long as the tree stands, regardless of how tall the tree becomes or how large around it may grow. The nail may eventually disappear as new rings of wood grow over it but it will never change its distance from the ground.

# CURRENT BULLETIN BRIEFS

*(Bulletins listed as being obtainable through Scientific American can be supplied only by mail)*

INVESTIGATION OF SUMMER COOLING IN THE WARM-AIR HEATING RESEARCH RESIDENCE, by Alonzo P. Kratz, Maurice K. Fahnestock, and Seichi Konzo, Bulletin No. 290, is a comprehensive report covering investigations of warm-air furnaces and furnace systems, and investigations of general problems in heating, ventilating, and air conditioning, undertaken in a residence type of building which may be considered as typical. Thoroughly illustrated. *Engineering Experiment Station, University of Illinois, Urbana, Illinois.—$1.00.*

BEER IN THE AMERICAN HOME, by Eloise Davison, is a 34-page brochure giving the facts on the brewing industry in general relation to the public welfare. Some of the typical divisions are: At Home With Beer, Beer—The Liquid Food, Beer's Care in the Home, Beer in the Menu. The last-mentioned chapter presents a series of suggested menus. *Write for Bulletin 837A, Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

EVOLUTION is the name of a journal about evolution, written for the layman and contributed to by outstanding men of science. Address *Evolution, 77 Albemarle St, Hempstead, New York.—$2.00 per year.*

COOPERATIVE ENTERPRISE IN EUROPE is a large report on an inquiry made by a corps of government investigators who traveled in ten European countries studying co-operative enterprises. *Superintendent of Documents, Washington, D. C.—65 cents, cash.*

TRI SODIUM PHOSPHATE—A CLEANER describes this white crystalline chemical, almost instantly soluble in water, and its multitude of uses as a cleaning compound. These uses cover such a diversity of applications as cleaning dishes and bath room fixtures in the home, soda fountains, as a boiler compound, in laundries, and for removing oil and grease from metal parts in manufacturing plants. *Grasselli Chemicals Department, E. I. du Pont de Nemours & Company, Inc., Wilmington, Delaware.—Gratis.*

THE PHYSICAL STATE OF THE UPPER ATMOSPHERE, by B. Haurwitz, is a 96-page reprint of a series of articles from the *Journal of the Royal Astronomical Society of Canada*, on meteors, ionization, terrestrial magnetism, auroras, ozone, and so on. *Blue Hill Meteorological Observatory, Harvard University, Milton, Massachusetts.—50 cents.*

THE ITINERANT PHOTOGRAPHER, by George H. Chappell, is an authoritative guide on the subject by one who has tramped the roads for years and who now, out of his fund of intimate knowledge based on successful experience, "tells all." His contention is that in this field a man "can start on a shoe-string and work up to big money." In his fact-crammed book, said to be the sary equipment, tells how to take and sell various types of pictures and what prices to charge, and includes many other helpful bits of advice. *Schoenig & Company, Inc, 8 East 42nd Street, New York City.—50 cents.*

INVESTIGATION OF ORGANIC COMPOUNDS AS INSECTICIDES, Bulletin 206, by H. G. Guy, is a comprehensive report of a thorough-going study of both toxic and non-toxic chemical compounds for the control of insects. *Agricultural Experiment Station, University of Delaware, Newark, Delaware.—Gratis.*

PICTURES TELL THE ARMCO STORY was originally prepared to instruct representatives of an industrial organization in the proper method of taking photographs to illustrate phases of their work. The instructions given, however, are so clear and concise that they will be of value to any amateur photographer. *Write for Bulletin 837B, Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

NATIONAL ARCHAEOLOGICAL NEWS is a new monthly journal for the amateur archeologist. Address *National Archaeological News, 1014 N. Christian St., Lancaster, Pennsylvania.—$2.00 per year.*

VIBRATION STUDY AND OTHER INDUSTRIAL APPLICATIONS OF THE NEO-BEAM OSCILLOSCOPE describes and illustrates a portable oscilloscope and accompanying accessories. It also gives general directions for making vibration measurements, and suggestions for uses of the oscilloscope in various industrial plants. *Write for Bulletin 837C, Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

SOLUTION CONTROL FOR ELECTROPLATING is a brief review of the subject, discussing the present need for scientific analytical control. *Grasselli Chemicals Department, E. I. du Pont de Nemours & Company, Wilmington, Delaware.—Gratis.*

TRACTOR AND IMPLEMENT TIRE HANDBOOK includes 22 pages of data that will be of value to any user of automotive farm equipment. It deals specifically with the advantages of pneumatic tires for this type of work. *Write for Bulletin 837D, Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

A TRIP THROUGH MELLON INSTITUTE is a comprehensive description of the new building that now houses the many activities of this co-operative institute. *Mellon Institute of Industrial Research, Pittsburgh, Pennsylvania.—Gratis.*

SHINGLED HOMES describes a method of treating wood shingles so that their beauty is preserved for many years. The treatment successfully eliminates the constant repairing of shingles which is necessary when untreated shingles are exposed

renders the shingles water-proof but also makes them fire-proof. *Roof Coating Corporation, 392-394 South Orange Avenue, Newark, New Jersey.—Gratis.*

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NEW HAM CATALOG was compiled exclusively for the radio amateur and short-wave broadcast fan. It lists complete lines of short-wave receiving and transmitting accessories as well as factory-built receivers and transmitters. Every nationally-known manufacturer is represented. *Write for Bulletin 837E, Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

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IF I ONLY HAD THAT BOOK is a comprehensive catalog of technical books of all American and British publishers. Thousands of books are listed and each is fully described in an attractive, spiral-wire bound catalog. Request Catalog #4. *Chemical Publishing Co. of N. Y., Inc., 148 Lafayette Street, New York City.—10 cents.*

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HARVESTING AND MARKETING TIMBER is a bulletin of particular interest to the owner of timber land, in that it shows how he can make more money by selling the timber rather than by getting out rough forest products or manufacturing lumber for sale. Particular emphasis is placed on the difficult problems of marketing. *New York State College of Forestry, Syracuse, New York.—75 cents.*

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A BALLOON, THE DEVIL AND A DROP, by G. D. Andrews, is a popular discussion of the technical problem of building insulation. It deals first with heating, air, and moisture, the three factors that are of particular interest to the home builder. It then shows how these three elements can be controlled to the best advantage to the home owner and his pocketbook. *The Celotex Corporation, Chicago, Illinois.—Gratis.*

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RADIO EQUIPMENT PROTECTION describes a new type of combination switch and circuit breaker, available in ratings from 50 milliamperes to 35 amperes, for the protection of tubes, transformers, condensers, and other radio equipment. *Heinemann Electric Company, Trenton, New Jersey.—Gratis.*

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RESERVE ILLUSTRATIONS is a collection of a large number of non-exclusive photographs, reproduced in small size, which are available for use by publishers and advertisers at a reasonable price. Anyone concerned with the production of articles or advertisements for publication will find in this spiral-bound book a convenient source of illustrative material. *Underwood and Underwood, 321 East 44th Street, New York City.—$1.75.*

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GRASSELLI ARSENATE OF LEAD is a folded circular describing in detail the application of arsenate of lead as a spray for the protection of fruit trees. *Grasselli Chemicals Department, E. I. du Pont de Nemours & Company, Inc., Wilmington, Delaware.—Gratis.*

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CARNEGIE INSTITUTION OF WASHINGTON, YEAR BOOK, 1936, is a large volume reporting on the many pieces of research done last year in archeology, biology, chemistry, genetics, meteorology, nutrition, paleontology and geology, physics, physiography, psychology and seismology in the various nationwide laboratories of the vast Carnegie Institution. *Office of Publications, Carnegie Institution of Washington, Washington, D. C.—One Dollar.*

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POISON IVY, Circular No. 154, is a four-page pamphlet telling how to recognize the poison ivy plant, how to treat cases of ivy poisoning, and how to eradicate the plants. *New York State Agricultural Experiment Station, Geneva, New York.—Single copies gratis. Two or more copies 3 cents each.*

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SCIENCE AND SOCIETY, by David Sarnoff, is a reprint of an address given before the American Physical Society. It deals specifically with the developments in technology and the effects which they have had upon public welfare. It reaches its climax in a plea that freedom of both science and society must be safeguarded. Published in the June issue of the *Journal of Applied Physics, 175 Fifth Avenue, New York City.—70 cents per copy.*

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ARMCO MULTI PLATE BRIDGES is the title of an attractive 16-page booklet, presenting a number of views of single, twin, and triple arch bridges, many of the illustrations being in full color. The text emphasizes the durability, strength, and ease of installation of these large corrugated structures. *Armco Culvert Manufacturers Association, Middletown, Ohio.—Gratis.*

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SOLAR ENERGY AND ITS USE FOR HEATING WATER IN CALIFORNIA, by F. A. Brooks, is a detailed study of the construction and performance of solar water heaters as successfully employed in the more sunshiny states. *Secretary of Publications, University of California, Berkeley, California.—Gratis within the United States.*

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DRIVER RATING MANUAL is a small pamphlet that outlines in detail a testing program for motor-car drivers, and indicates the principal factors which may cause or avoid accidents. The booklet will help anyone who is trying to do something about avoiding trouble and accidents on the highway. *American Automobile Association, Washington, D. C.—10 cents.*

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AMERICAN SEAMLESS FLEXIBLE METAL TUBING, Bulletin SS-3, describes the method of fabricating this type of tubing and illustrates many of its forms and industrial applications. *American Metal Hose Branch, The American Brass Company, Waterbury, Connecticut.—Gratis.*

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TIME RULES TRANSPORT is a specific discussion of speed and roadway safety, with particular attention to the so-called "streamlined" trains that are becoming increasingly popular throughout the country. *Bureau of Public Information, New York University, Washington Square, New York.—A limited number of copies are available for distribution gratis.*

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ACCIDENTS—YOUR LEGAL RIGHTS AND HOW TO PROTECT THEM, by George Ward, is a manual for the victims of various types of accidents. It contains information, nowhere else available, by which you can determine what damages are legally due you and effectively direct the negotiations or law suit which will secure them. *The Research*

# LEGAL HIGH-LIGHTS

## Patent, Trademark, and Related Legal Proceedings That May Have a Direct Effect on Your Business

By ORSON D. MUNN, Litt.B., LL.B., Sc.D.
New York Bar
Editor, Scientific American

### Too Warm

IN a recent suit for unfair competition the plaintiff, Burns Brothers, sought an injunction restraining the defendant from using the name Bruns Brothers. The Court found that the plaintiff was an established and well-known concern and that the defendant had only been organized within the past month for the purpose of engaging in the same business as the plaintiff. The Court then stated: "The defendant's name is obviously so similar to that of the plaintiff that it is calculated to deceive and mislead the public. The transposition of the two letters 'ur' is clearly a subterfuge."

Apparently in the course of the proceedings the Court had inquired as to how the defendant happened to select the name "Bruns Brothers" and in reply was advised that it was a "pure coincidence." In commenting on this reply the Court stated: "There is nothing coincidental about it and certainly the word 'pure' in connection with this transaction was entirely out of place."

### Celestial and Terrestrial

YOU may not register the map of a country as a trade mark under the Federal Trade Mark Act of 1905, but, according to a recent decision of the Court of Customs and Patent Appeals, you may register the representation of the terrestrial globe. As pointed out on this page under the heading "Cartography" in the May, 1937, issue of Scientific American, the Trade Mark Act of 1905 bans the registration of a trade mark which is "merely a geographical name or term" and under this provision the Court of Customs and Patent Appeals sustained the Commissioner of Patents in his refusal to register the map of Canada as a trade mark for ginger ale.

In a more recent decision the Court had occasion to consider whether the word "globe" and the representation of a terrestrial globe are merely geographical within the meaning of the statute and therefore not the proper subject matter for trade-mark registration. The Court first concluded that the word "globe" is not merely a geographical name or term and pointed out that "a geographical name or term to our minds signifies a nation, state, country, city, municipality, river, lake, or the like." The Court also concluded that the representation of the terrestrial globe was not merely a geographical name or term and elaborated on its former reasoning as follows: "The same reasoning leads to the conclusion that a figure of the globe representing the earth is not in the sense of the statute a representation of merely a geographical name or term; it is of the terrestrial body. 'There are also celestial bodies and bodies terrestrial * * *'. The Congress in the Trade Mark Registration Act did not ban the celestial nor the terrestrial but stopped with geographical names and terms."

From the above opinion we suppose that the conclusion logically follows that a geographical name or term may not be registered as a trade mark but that a celestial or terrestrial name or term may be registered. We trust that none of our readers will have to consult a geographer to distinguish between "geographical" on one hand and "celestial" and "terrestrial" on the other.

### Notice

WHY should the owner of a patent affix to the patented article which he manufactures and sells the patent notice required by law? Will he be benefited if he affixes the notice? Will he be penalized if he omits the notice?

The patent statute provides that "it shall be the duty of all patentees and their assigns * * * * to give sufficient notice to the public that the same is patented" either by affixing to the patented article the word "Patent" together with a patent number or by attaching to the article or the package in which it is contained a label bearing the same notice.

It is quite clear that it is the intention of the statute that all articles made and sold under a patent should bear the patent notice. Frequently, however, through choice or neglect a patentee omits the notice from the patented article. What is the effect of this omission? The statute provides that where the patentee fails to affix a notice to articles manufactured or sold by him or with his consent, in a suit for patent infringement he shall not recover damages unless he proves that he actually notified the infringer of his infringement and that the infringer continued the infringing acts after he was notified. Under this provision damages have frequently been denied to a patentee because of his failure to affix the proper patent notice to a patented article.

In a recent case in the Federal District Court for the Eastern District of Pennsylvania the owner of a patent for a loose-leaf book was denied damages in a suit for infringement of the patent because his licensee had failed to affix the statutory patent notice to books made under the license. Accordingly, it will be seen that affixing the statutory patent notice to a patented article lays the groundwork for collecting damages in a suit for patent infringement. The penalty for omission of the notice is that the patentee is deprived of the right of collecting damages in a suit for patent infringement unless he proves that he gave actual notice of infringement to the infringer and that the infringing acts were continued subsequent to such notice. In the latter case the courts have held that the patentee's damages are limited to the infringing acts occurring after the notice.

In seeking to obtain the advantages of the statute providing for patent notice a patentee should be careful not to become over-enthusiastic and falsely mark unpatented articles with a patent number. Another section of the patent statute provides for a penalty of 100 dollars where an unpatented article has a patent notice affixed thereto for the purpose of deceiving the public. The penalty for applying a false patent notice to an unpatented article is penal in nature. In those cases where a person flagrantly falsely marks an article with a patent notice for the purpose of deceiving the public, the penalty will be applied.

### Insubordinate?

IT is frequently assumed that a decision of the United States Supreme Court sustaining a patent is binding upon all inferior courts of the United States and that no inferior court can thereafter declare the patent to be invalid. As a general rule, the validity of a patent is not seriously questioned after it has been sustained by the Supreme Court. However, there are cases where a federal district court or circuit court of appeals can declare a patent invalid after it has been sustained by the Supreme Court.

A recent example of such a case is to be found in the proceedings involving the infringement of patent No. 1,262,860 for a Method and Apparatus for the Incubation of Eggs. This patent had been extensively litigated and in 1935 the United States Supreme Court held that claims for the method of incubating eggs were valid. Thereafter in another suit on the same patent the United States Circuit Court of Appeals for the Second Circuit held that the same claims were invalid. The decision of the Circuit Court of Appeals holding the claims invalid was recently reviewed by the United States Supreme Court and was sustained. In reaching this decision the Supreme Court pointed out that new evidence relating to a prior use of the invention was introduced in the second proceeding and that the new evidence clearly showed that the invention had been used prior to the date of invention by the patentee.

The prior use of the invention was by a man named Hastings and the court pointed out with regard to the first case: "But in that case the Hastings prior use was not presented or considered." It then stated: "In view of the definition given to the patent by our decision, the Hastings defense assumed an importance in these suits apparently not attributed to it in earlier litigation, and it has been developed in the records now before us more fully than in any earlier case."

Thus while a decision of the Supreme Court sustaining a patent is normally binding upon all district and circuit courts of appeals, in a suit against a different infringer in which new evidence has been introduced clearly showing the patent to be invalid, the inferior court may on the basis of the new evidence declare the patent to be invalid.

# Books SELECTED BY THE EDITORS

### GENERAL PHILIP KEARNY

*By Thomas Kearny*

"A DASHING dragoon, the Murat of the American Army" is the title given Kearny in a classic tale of his exploits by the well-known author Captain Mayne Reid. He was this and more. Having been sent to Europe for advanced cavalry study, he took part in the Algerian campaign with the French and was with the French and Italians at Solferino. It is granted that had he been allowed to complete his famous cavalry charge at Mexico City during our Mexican War the American Army would have entered that city almost a month earlier than it actually did. During the Civil War he served brilliantly and was on the point of taking over command of the Army of the Potomac when he was killed by Confederates in a reconnoitering expedition. This long biography of General Philip Kearny therefore covers considerable history of the United States with references to military campaigns and political maneuvers which led up to and continued during the Civil War. Many reports and letters throwing light on various incidents, and military operations are necessarily included. Kearny shines through many of these as the saver of battles for the North and he was brusquely outspoken in his criticism of McClellan on several occasions when General McClellan ordered retreats when victory was in sight. This book is vital and interesting but its style is so explosive and exclamatory as to be very difficult to follow in places.—$4.20 postpaid.—*F. D. M.*

### MEN OF MATHEMATICS

*By Eric T. Bell, Prof. Mathematics, California Institute of Technology*

A LIVELY, most readable account of the lives, some of them eccentric, of the great modern mathematicians of the world, with accounts of the more outstanding and intrinsically interesting parts of their mathematical discoveries. Descartes, Fermat, Pascal, Newton, Leibnitz, Euler, Lagrange, Gauss, Riemann, Poincaré, and 17 others are dealt with. The mathematics included is of high-school grade, but may be skipped without loss of continuity if the reader wishes merely to enjoy the biographical accounts. Bell's style of writing is notable: he has a flair for speaking out of turn, and making no discreet omissions, works. If there is a sore, touchy spot, that is where he puts a finger. He is also slyly humorous. Fine reading.—$5.25 postpaid.—*A. G. I.*

### THERMODYNAMICS

*By Professor Stanton E. Winston*

A PRACTICAL text covering the fundamentals of thermodynamics that are basic to the engineering field, this is in reality an advanced textbook of 178 pages, illustrated.—$1.65 postpaid.—*F. D. M.*

### MARINE GAME FISHES

*By Lionel A. Walford*

COVERING the western coast of the Western Hemisphere from Alaska to the Equator, the author has gathered scientific and popular information on all of the game fishes that inhabit these waters. In an excellent arrangement that makes for easy reference, he has presented this data for the student or the sportsman who wants to know all that is available about these fishes. A comprehensive text, illustrated with small drawings, is supplemented by 69 plates, many of them in colors, showing not only the fish themselves but giving additional data about them and illustrating some of the equipment with which they are taken by angling. It is a beautiful book in every respect—typography, paper, printing, and illustrations. $8\frac{1}{4}$ x $11\frac{1}{4}$.—$5.20 postpaid.—*A. P. P.*

### PRESS AGENTRY

*By Charles Washburn*

A BROADWAY press agent tells how it is done, from first primer to stunts and ballyhooing. His book is breezy, chatty, and practical. Read it to learn how to do likewise, or else to acquire wisdom concerning the methods by which press agents work on you and the world and his wife when you are off guard. Good reading.—$2.15 postpaid. —*A. G. I.*

### JANE'S FIGHTING SHIPS 1936

*Edited by Francis E. McMurtrie*

ABANDONMENT of the principle of quantitative limitation of the world's navies by treaty makes this newest edition of a famous old authority decidedly years. The volume as usual contains data concerning the naval vessels of all naval powers of the world, large and small; includes photographs of most of the important ships—profiles and plans of others. Included also are data concerning the dimensions, displacement, armor, and armament. Some data are given on new construction, and the editor discusses in a foreword certain specific details regarding building programs, treaties, and so on. This edition is exceptionally well done.—$22.50 postpaid.—*F. D. M.*

### INTRODUCTION TO THEORETICAL CHEMISTRY

*By Meldrum & Gucker*

IN modern science, theory supplies the framework which relates vast numbers of facts into a unified whole. This book, intended primarily as a text book for those already familiar with the elements of chemistry, presents the important theories of chemistry. It is in no sense an experimental work, but does provide illustrative problems to bring out the applications of each theory as discussed. It is of special value to those who find themselves confused by multitudes of facts.—$3.70 postpaid.—*D. H. K.*

### THE SPECTACLE OF A MAN

*By John Coignard*

THE man who is here called Arnold Harvesting was driven to seek help of a psychoanalyst for the extreme shyness and torturing jealousy which were dominating his life. This is the story, told in novel form by his doctor—and at the patient's own suggestion—of what took place inside the doctor's office and in the world without, during the dramatic days which witnessed the unraveling of his problems.—$2.65 postpaid.—*A. G. I.*

### PERFECT PRINT CONTROL

*By Laurence Dutton*

THERE is more to turning out a perfect photographic positive than just making a good negative and printing a picture. Whether you are working with contact prints or project enlargements, there are many variables that can have a definite effect on the finished product. How to achieve a certain desired tonal quality is the one main lesson that this book endeavors to teach. The author pre-

which, if carefully followed, reduces the variables to a minimum and enables the amateur to turn out photographic prints of which he can be proud. The book is written in non-technical language and includes a vast amount of tabular and factual information on negative densities, paper emulsion speeds, and illumination control. The text may be considered as a very satisfactory approach to the problem of printing technique.—$2.65 postpaid.—*A. P. P.*

MACHINE SHOP OPERATIONS

*By J. W. Barritt*

EVERY operation of the machine shop from the care and use of tools to precision grinding and drilling. Composed of 13 sections averaging 30 to 50 pages each, this volume is of loose-leaf type in leatherette covers. It is essentially a student's volume, but would be an invaluable aid to the machinist, the foreman of a machine shop, or the owner of the business.—$5.20 postpaid.—*F. D. M.*

THE WORLD OF ATOMS

*By Arthur Haas, Ph.D., Professor of Physics, University of Vienna*

A COMPACT, succinct statement of the general content of modern atomic physics, for the reader who prefers to study rather than merely read, and who already has a fair background in physics. This is the second and revised edition of an earlier work. The author is at present professor of physics at Notre Dame.—$3.15 postpaid.—*A. G. I.*

GIRL AROUND THE WORLD

*By Dorothy Kilgallen*

NEWSPAPER readers undoubtedly remember the "'round the world race by air" in which three newspaper correspondents took part during October 1936. One of the correspondents was a young lady, author of the present book, and here she gives the complete story of the mad, pell-mell dash. She did not win, but she apparently had a lot of fun. This fun, with some of the breathless, rushing spirit of the race, is ably transferred to the pages of this book. With a series of photographs and a few drawings, it makes excellent and entertaining reading.—$2.15 postpaid.—*A. P. P.*

WHO'S WHO AT THE ZOO

*Edited by Ralph De Sola*

THIS attractively produced book is a product of the WPA Federal Writer's Project and contains a splendid collection of photographs of animals both common and uncommon, with accompanying descriptive matter in popular style. It is mainly accurate and readable as well, but contains statements about animals that smack of old wives' tales. Moreover, a real howler, from a scientific standpoint, the Haitian solenodon, a mammal, is believed to be descended from the dinosaurs. The ten good scientists whose names are dragged into the preface because they "co-operated," and whose help and co-operation it is claimed went "far" to insure "scientific accuracy," are not themselves responsible for the misinformation offered by the writers to the public and prepared at public expense. However, the book—yes, even the old wives' tales in it—is interesting.— $1.85 postpaid.—*A. G. I.*

THE NEW VISION LOCOMOTIVE

*By Raymond Loewy*

THE artist-designer who was responsible for streamlining the Pennsylvania Railroad's two new types of locomotive here accompanies about 100 large photographs of streamlined locomotives in America, Austria, France, Germany, Great Britain, the Netherlands, Norway, Soviet Russia, and the Far East, with brief, compact, pointed critiques of each type.—$2.65 postpaid. —*A. G. I.*

COLLOID CHEMISTRY—4th Edition

*By Jerome Alexander*

MATTER has strange properties in a state of aggregation greater than the molecules of the chemist but smaller than any discrete particles we are able to observe by ordinary means. This is the subject matter of colloid chemistry which this book treats in a most interesting manner. Applications of its principles are described in many fields extending throughout the arts and manufactures. A vast amount of information both of an experimental and a descriptive nature is included. The book presupposes a more-than-passing acquaintance with chemistry. The present fourth edition indicates the continuing interest in the subject matter.—$4.70 postpaid.—*D. H. K.*

LET'S MAKE A PORTRAIT

*By Alfred de Lardi*

WRITTEN in a free and personal style that takes the reader at once into the confidence of the author, the process of making a portrait is here put forth in perfectly simple language. The compact text covers equipment, lighting from all angles, subject arrangement, outdoor photography, and the very vital phases of processing. There are only 95 pages of text, but they are meaty, compact, informative. Well illustrated.—$1.15 postpaid.—*A. P. P.*

PRELUDE TO CHEMISTRY

*By John Read, Ph.D., Prof. Chemistry, University of St. Andrews*

AN outline of alchemy, its literature and relationships. Many students of the science of chemistry who take an antiquarian interest in their science often wish to be at least informed, or perhaps merely amused, regarding its thoroughly disreputable early ancestor, the pseudo-science of alchemy (parallel to astrology, the reprobate great-granddaddy of astronomy). Such bibliophiles will find much ancient lore in this book.—$5.20 postpaid.—*A. G. I.*

ATOMIC STRUCTURE OF MINERALS

*By W. L. Bragg, Professor of Physics, Victoria University of Manchester*

PRIMARILY a discussion of mineralogy from the point of view of the new information made available by the X-ray crystal structure analysis of minerals. The treatment is not popular but rather technical, although there are introductory chapters explaining the special technique of this work. Practically all the important minerals are given systematic discussions. There are 143 photographs and drawings.—$3.90 postpaid.—*A. G. I.*

GUIDE DE L'OUVRIER EN VERRES D'OPTIQUE DE PRECISION

*Par le Colonel Charles Dévé, Directeur de l'Institut d'Optique théorique et appliquée*

LES verres, leurs défauts, les aberrations, le choix des matières. Abrasifs, colles, mastics, résines et ciments, outils, polissoirs, éponges, chiffons, pinceaux. Surfaçage: les locaux, conditions d'usure uniforme du verre, ébauchage, doucissage et polissage, surfaces cylindriques, surfaces toriques, déformations thermiques, travail des miroirs métalliques. Théorie mécanique du travail des surfaces optiques. Optique de lunetterie. Vérifications optiques à l'atelier: les calibres et le surfaçage au nombre de franges, parabolisation, vérifications des lames à faces parallèles, vérification des angles. Polarisation de la lumière, taille des cristaux. Centrage, débordage, collage des verres. Réticules, micromètres et graticules.

Cet ouvrage s'adresse à tous les opticiens désireux d'acquérir des connaissances plus étendues sur les opérations manuelles de leur métier; c'est une véritable encyclopédie des tours de mains de l'ouvrier opticien avec l'explication technique de chacun d'eux.

The emphasis is partly on eye-glass work, but close work also is treated.

Communicate direct with the publishers, *la Revue d'Optique*, 165 Rue de Sèvres, Paris XV^e^.—*A. G. I.*

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# The SCIENTIFIC AMERICAN DIGEST




# SCIENTIFIC AMERICAN

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NINETY-THIRD YEAR • ORSON D. MUNN, Editor


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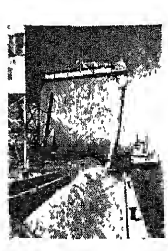

SULFUR plays an important part in 70 industries. In the illustration on our cover, sulfur, 99½ percent pure as it is mined by the Freeport Sulphur Company, is being loaded on Mississippi River barges, ten miles from Grande Ecaille, Louisiana. Sulfur is melted out of limestone by superheated water under pressure, and forced to the surface in liquid form. To make production possible at Grande Ecaille, engineers perfected the "mudding" process, pumping 4,000,000 tons of mud into the wells to prevent the water from escaping through unusually porous strata.


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# 50 Years Ago in . . .

# Scientific American

*(Condensed From Issues of September, 1887)*

BOONDOGGLE?—"It appears that the government is now employing three different scientific corps to investigate and report on one and the same matter, namely, the characteristics of genuine butter and its limitations. In the first instance, we have the division of microscopy of the agricultural department . . . then we have the division of chemistry of the same department . . . and lastly the office of commissioner of internal revenue, represented by a chemist and a microscopist."

$CO_2$—"The fiery, untamed soda-water tank, which has chiefly distinguished itself since the advent of hot weather this year by bursting and killing or maiming its attendants, has made a new departure, says *Fire and Water*, and now appears in the rôle of a most efficient extinguisher of fire. . . . Before a fire (in a drug store) could gain headway, the heat had melted the lead pipe connected with the newly charged soda fountain, and the flames were instantly extinguished."

LIGHTNING RODS—"If we are to believe an Austrian paper, says *La Lumière Électrique*, the first lightning rod was not constructed by Franklin, but by a monk of Seuftenberg, in Bohemia, named Prohop Diwisch, who installed an apparatus the 15th of June, 1754, in the garden of the curate of Prenditz (Moravia)."

SENEGALESE YACHT—"In these days of yachting we have thought it might be of interest to our readers to see what sort of a yacht they sometimes use in Ceylon. . . . The boats have in themselves no stability, having only about 8 inches beam, and are kept from capsizing by an outrigger. In the event of a heavy squall, when the outrigger is not sufficient for the preservation of stability, one of the crew acts as shifting ballast, and perches himself on the outrigger—this is called a one man breeze. A two man breeze is serious work. The construction of these boats enables them to run over the shallow reef water, and our sketch shows the passage of a river bar under sail, the boat being rushed through the 'white horses' at a rapid pace under the freshening gale. It is rather exciting work when, amid the green rollers on the bar, naught of the land can be seen in dipping save the tops of the cocoa nuts that fringe the shore. The Singhalese (*sic*) fishing boat has a graceful motion, but it is best admired from *terra firma*."

NAVAL MANEUVERS—"The recent maneuvers of the British fleet did little to encourage those who pin their faith to monster ships and heavy armor. Indeed, even the unbelievers in this type were scarcely prepared for the sorry spectacle presented by the mightiest fleet afloat, for in the Irish Channel, where Admiral Baird essayed to defend the shore line against the assault of Fitzroy, and again in the English Channel and North Sea, when Hewitt sought to pierce the line of Freemantle, the big ships proved at best both awkward and uncertain."

COIN PHONE—"The subscribers of the telephone line in St. Louis, says an exchange, do not pay a fixed subscription to the company, but merely the sum of five cents for each communication. . . . Above the transmitter there is a box containing a slit in the upper part. When the subscriber wishes to communicate with anyone, he places a five-cent piece in the slit and takes the receiver from its hook. The coin, in sliding, closes a circuit, a call is made at the central office, and the subscriber can talk as long as he pleases, either with the office or another subscriber."

RUBBER BELTS—"The high standard of efficiency which can be realized by the employment of strictly first-class rubber belts is now receiving merited recognition from users who have had them in severe service for many years, and whose experience cannot fail to be of value to all mill owners and furnishers of factory equipments. . . . In the picture may be seen a belt 2,700 feet long, recently made for the Pennsylvania Railroad Company, and in use in one of their grain elevators in Jersey City. This belt is used to convey grain from one end of the immense building to another, the grain being delivered upon the belt from another belt. . . . The belt runs on small rollers, and there is a simple form of tightener at the ends, by which it can be readily kept straight and even."

ICED FISH—"In the United States ice was first used for the preservation of fish about the year 1842, and in 1845 fishing vessels began to take ice to preserve their catch. At first they were careful to keep the ice separate from the fish, piling it in a corner of the hold, but they soon began packing the fish in broken ice. The inland trade in fresh fish had, up to that time, been very limited, but soon increased, and it was not many years before boxes of fish packed in ice were shipped far inland."

SCARLET FEVER—"Drs. W. Allan Jamieson and M. Alexander Edington, of Edinburgh, announce, in the last *British Medical Journal*, the discovery of a specific bacillus of scarlet fever. The micro-organism has been isolated, cultivated, and put through its paces generally, coming out, apparently, with a specific character."

ICE LENSES—"The London correspondent of *Le Moniteur de la Photographie* writes to that journal that in the middle of the winter which has just elapsed a student made a lens of ice, with which he lit the pipes of some of the skaters on the Serpentine by means of the solar rays, an experiment, he says, which was first performed in the polar regions by Dr. Scoresby, to the great astonishment of the sailors, for they could not understand why the ice did not freeze the beams of the sun."

BRICKS—"Enameled or glazed bricks, for outside or interior decoration, are made by applying to the surface a flux, which, during the burning, causes the silex to melt and form a vitreous covering. Such flux is easily colored, and thus very beautiful fancy bricks are produced."

**AND NOW FOR THE FUTURE**

**Turbines: Most efficient steam power plants today. By Philip H. Smith.**

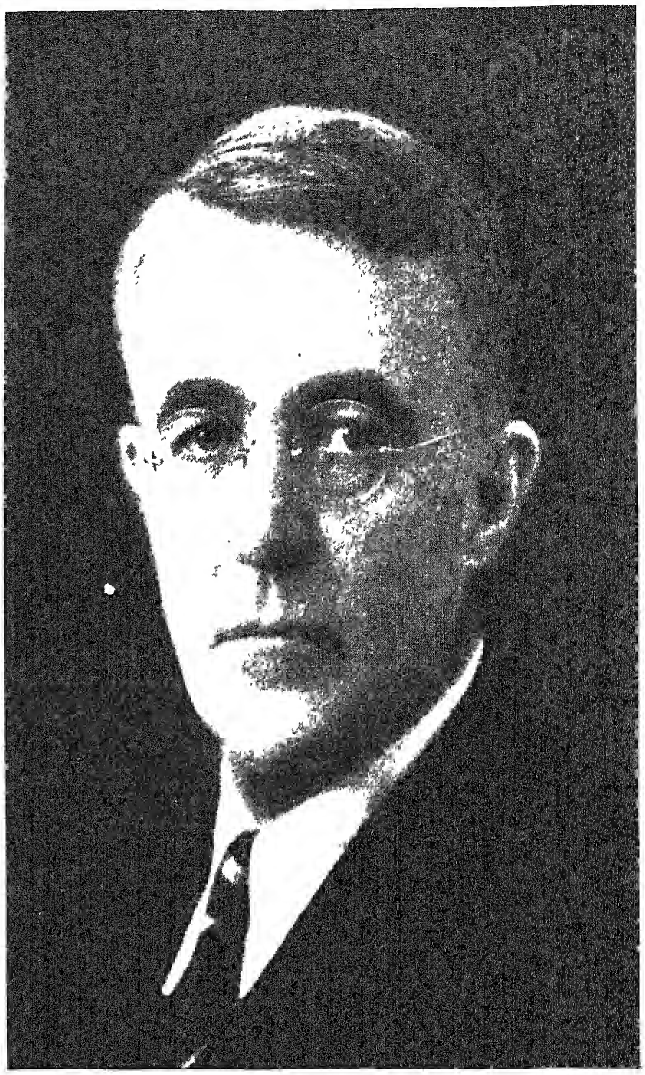
**Peace-Time Preparedness: How radio has become a powerful support of the armed forces. By General J. G. Harbord.**

**Personalities of the Elements: Electrons—genes of the atom—the determining factors. By Sidney J. French, Ph.D.**

**Coal Carbonization: A new process that has advantages for the coal industry and the community. By H. Stevens.**

**How Climate and Weather Exert a Dictatorship Over Man and Many of His Activities. By Clarence A. Mills, M.D., Ph.D.**

# *Personalities in Science*



**DR. IRVING LANGMUIR**

ASKED by Colonel Lindbergh which he liked the better, flying or skiing, Dr. Langmuir caused the other dinner guests to gasp by the prompt frankness of his reply: "Skiing." Since Dr. Irving Langmuir, associate director of the research laboratory of the General Electric Company and Nobel Prize winner, owns his own plane which he pilots himself and enjoys hugely, it remains for Colonel Lindbergh to climb Mt. Marcy on skis with him before they can settle the question between them.

Dr. Langmuir is anything but the prototype of the average conception of a great scientist. A mental genius, he claims that the theory for some of his best work has come to him while motor boating at his camp at Lake George in the Adirondacks or skiing in Switzerland.

Dr. Langmuir's researches in surface chemistry, his studies of molecular films of a thickness of about one ten-millionth of an inch, and his discoveries in this invisible film world, resulted in his becoming the first industrial chemist in this nation to receive the coveted Nobel Prize in chemistry which the Swedish Academy of Science awarded him in 1932.

There is scarcely a person living today who has not benefited by his research and discoveries. His creation of the gas-filled incandescent lamp, which now saves the American people a million dollars a night in the cost of illumination; the high-vacuum electronic tube; and the atomic hydrogen method of welding, are a few of the reasons why Dr. Langmuir is recognized as one of the outstanding scientists of the world today. He has a rare facility for seeing beyond the horizon of already known facts.

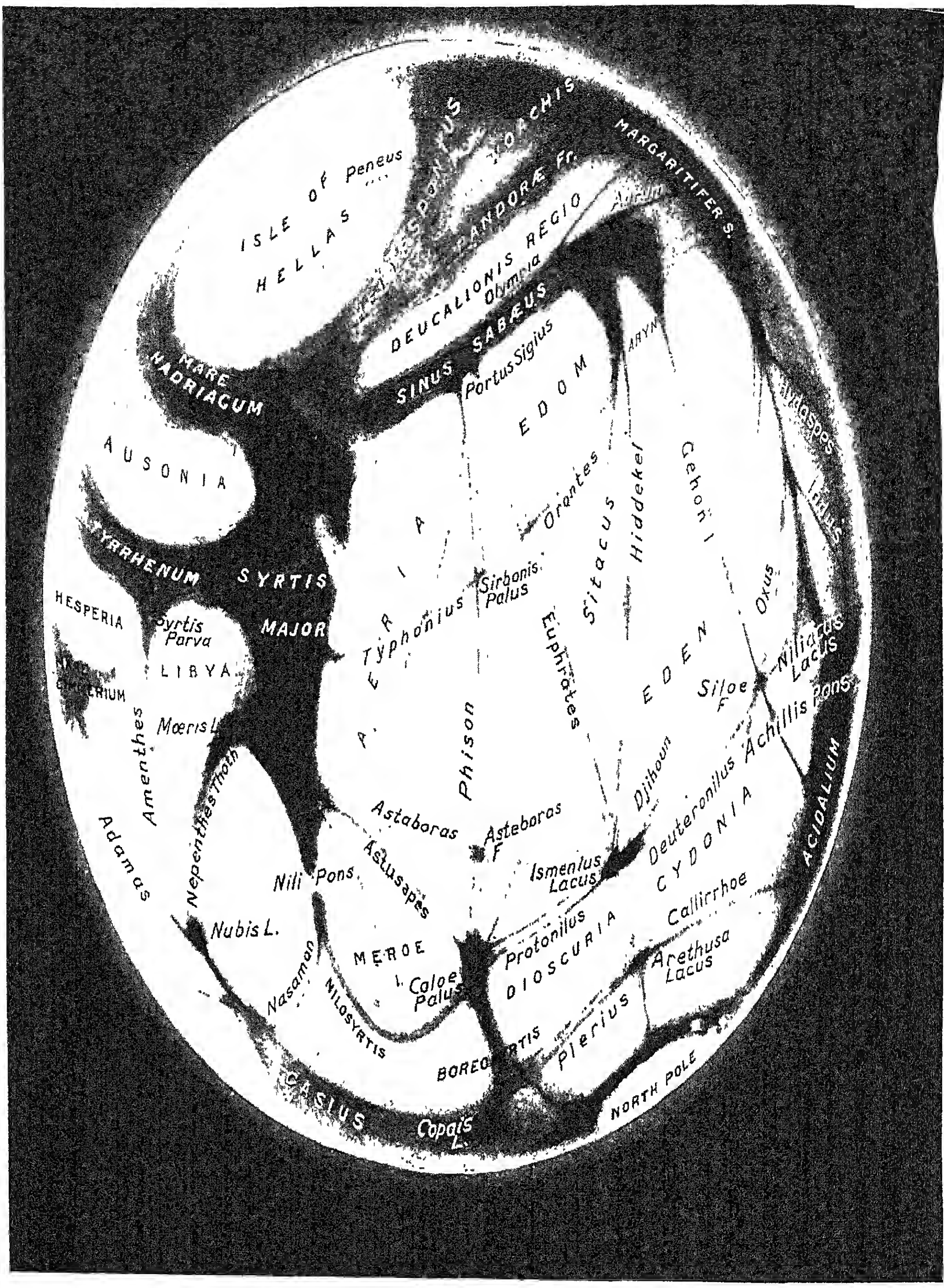
Born in Brooklyn, he attended the public schools there until his parents moved to Paris where he studied in French schools for three years, returning to the United States where he entered Chestnut Hill Academy at Philadelphia. He then attended Pratt Institute high school and upon the completion of his course there, entered the School of Mines at Columbia University from which he was graduated in 1903 with the degree of Metallurgical Engineer. He did post-graduate work at the University of Göttingen, being awarded his Ph.D. in 1906, his subject having been physical chemistry. Returning to America, Dr. Langmuir became instructor in chemistry at Stevens Institute of Technology, where he taught until he entered the research laboratory of the General Electric Company in 1909.

Dr. Willis R. Whitney, former director of the laboratories, referred to Dr. Langmuir as "one of the world's greatest explorers of the vacuum who continually embarks upon mental voyages in regions so nearly airless that only the mind can breathe in comfort."

Besides the Nobel Prize, he has won many other distinctions including: the Nicholas Medal in 1915 and again in 1920; the Willard Gibbs Gold Medal; the Hughes Medal from the Royal Society of London; the Rumford Medal; the Perkins Medal; the Chandler Gold Medal awarded by Columbia University; the *Popular Science Monthly* prize of 10,000 dollars with Gold Medal; and the Gold Medal of the Franklin Institute. The Royal Academy of Rome awarded him the Cannizaro Prize in 1925, and in 1934 the government of Japan awarded him the Fourth Order of the Rising Sun. He was elected president of the American Chemical Society in 1929, and the American Society of Mechanical Engineers awarded him the Holley Medal in 1935, the same year he was elècted to membership in the Royal Society of London. He is the only American industrial scientist so honored in that Society, which limits its foreign membership to 50 persons throughout the world. The City of Philadelphia awarded him the John Scott award this year.

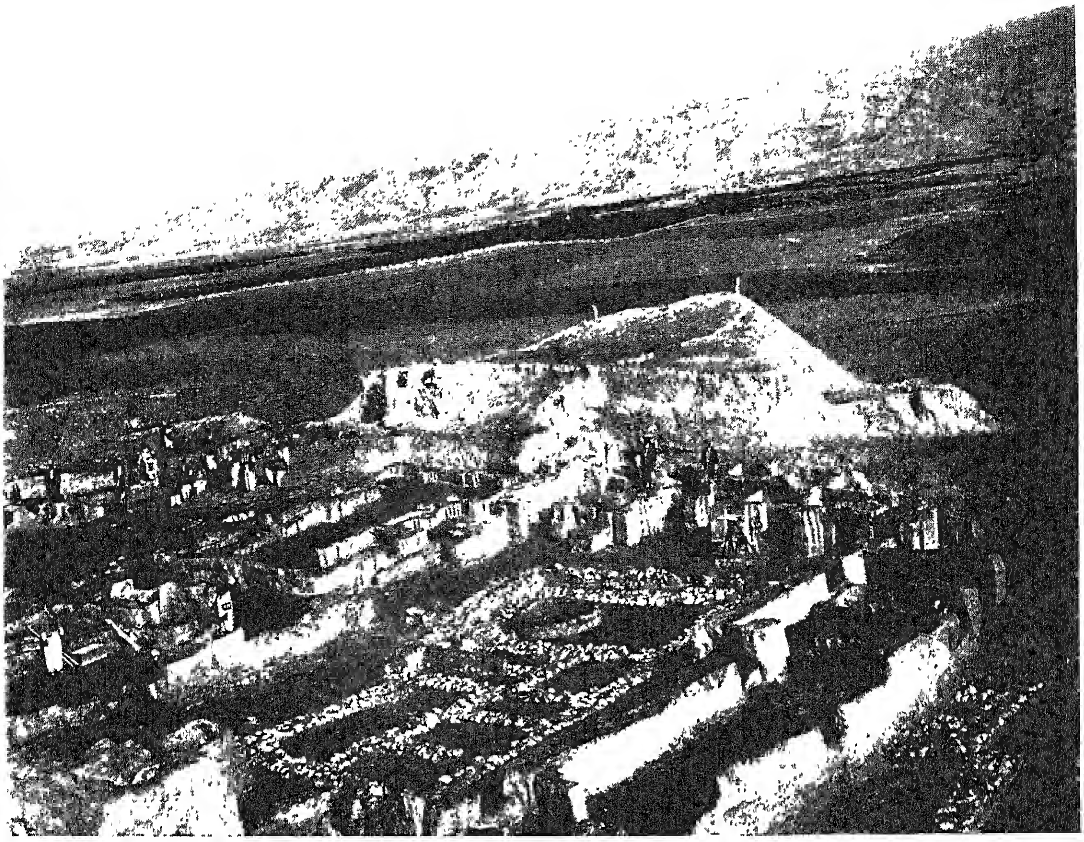
Many colleges and universities have awarded him honorary degrees and he was made honorary chancellor of Union College in 1934. He has published 167 papers and has been granted a multitude of patents.

We are privileged to announce that Dr. Langmuir has accepted an appointment to our staff of Contributing Editors. It is an honor to have him thus associated with us so that we and our readers may have the benefit of his advice and counsel.




**MARS AS THE EXPERT DRAWS IT**

THE above drawing was made by G. F. Morrell, F.R.A.S., F.R.G.S., and is reproduced by courtesy of the *Illustrated London News.* With reference to such drawings Professor Henry Norris Russell writes: "The novice, having seen these, and looking at Mars through the telescope, or at the best photographs of the planet, is likely to be seriously disappointed when he fails to see the conspicuous network of canals. It is not, however, practicable for anyone but a highly trained artist to represent pictorially such delicate shadings and fine distinctions of tone as are characteristic of the Martian surface. What is desired from the scientific viewpoint is as accurate a representation as may be of the surface features which may be observable—their positions, their mutual relations and connections, and their relative intensities. A drawing which exaggerates the absolute intensities of the features, but gives them accurately in position and relative strength, is quite satisfactory in the present state of the art."



A general view of the acropolis of Gawra 13, with the stone foundations of Level 14 in the foreground

# NEW FINDS AT TEPE GAWRA

## The Fame of Gawra Grows Steadily as Sixteen of its Superimposed Settlements are Excavated . . . All Progressively Richer and More Significant


By E. A. SPEISER

Professor in the University of Pennsylvania and Director of the American School of Oriental Research in Baghdad

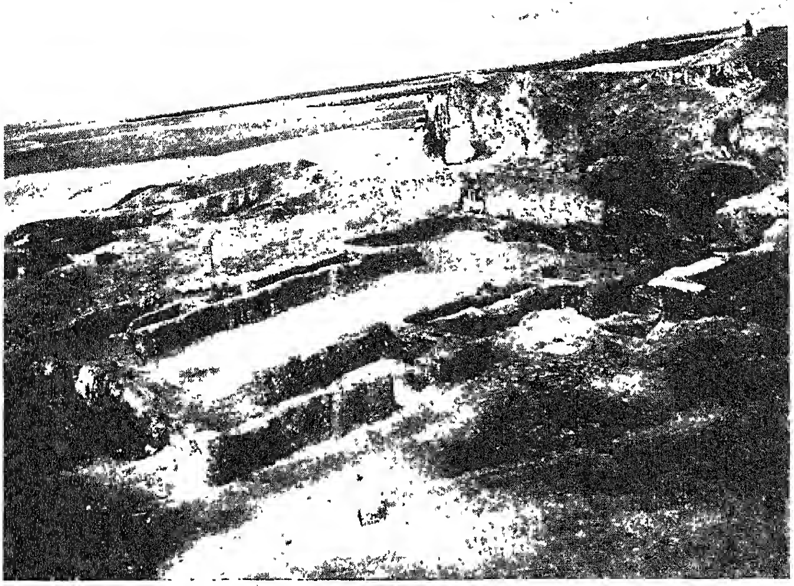

TO the neighboring villagers the site has been known traditionally as Tepe Gawra, "The Great Mound." A strange appellation, this, coming from unlettered peasants. Ordinarily they are little impressed by ancient remains. Even the vast ruins of Nineveh, 15 miles to the south, never have been similarly honored by the natives. Tepe Gawra must have appealed to them because of its height, enhanced by a regular and conical shape. The name thus reflected outward appearances. No thought was given to what may have lain buried inside.

Today the scientific world regards the designation as amply justified. But the greatness which archeologists have recognized in Gawra is linked only in an indirect way with the original height of the mound. It is the story revealed by its contents that has made the site, ignored on all maps as recently as ten years ago, one of the best known and most frequently cited centers known to archeology. Paradoxically enough, the fame of Gawra has been growing steadily with each successive decrease in its height. For the removal of a few feet of débris would mark the addition of yet another occupational level to the recorded history of the place. And, as one descends gradually in the process of systematic excavation from the top down, each new stratum proves more significant, because it brings us closer and closer to the earliest stages of settled mankind.


Courtesy University Museum Bulletin

Showing the location of Tepe Gawra in Iraq—in southwestern Asia

Height alone is no sufficient guarantee that a mound will prove of particular significance to science. The tallest heaps



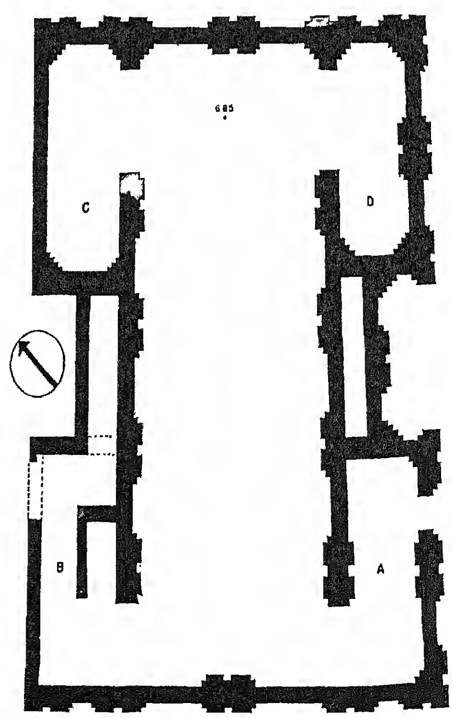
The Northern Temple at Gawra, dating from the Fifth Millennium before Christ, or more than 6000 years ago. Found in Level 13. Its architecture was far in advance of its time

of stratified ruins in ancient Mesopotamia are generally also the least interesting. The reason is not far to seek, for at the top of such an average mound you will find usually Graeco-Roman or Parthian remains, covering older occupations of the Persian period, which in turn are superimposed upon Assyrian levels. Now I would not deny for a moment the importance of every scrap of information bearing on Hellenistic or Assyrian settlements. But the fact remains that those periods are by now fairly well known in their main outlines. Consequently, excavation of such sites involves of necessity a great deal of duplication of knowledge. For this reason I had my misgivings when I first came upon Tepe Gawra in the spring of 1927. They were soon to be dispelled.

FOR a year I had been engaged in a systematic archeological reconnaissance of northern Iraq. In the course of that survey I had visited and examined more than 300 ancient sites. Tepe Gawra was one of the last mounds to be included in my investigation. It took only a few minutes to realize that here was no ordinary witness of ancient times. Surface remains, such as scattered potsherds and small implements of flint and obsidian, left no room for doubt that the site had not been occupied since 1500 B.C. In other words, when the younger Sargon of Assyria, a contemporary of the prophet Isaiah, built his capital Dûr-Sharrukên (modern Khorsabad) barely two miles to the west, Gawra had been a tall and mysterious artificial hill for some 800 years. A mound rising more than 70 feet above the level of the plain is certain to contain a number of buried occupational layers. If the uppermost one is older than the time of Moses, how far back would the lowest one take us? Excavation alone could answer this question satisfactorily.

We lost no time in getting started. A preliminary dig of two weeks' duration, undertaken in the autumn of that same year with the assistance of the Dropsie College of Philadelphia and the Guggenheim Foundation, fully bore out the astounding antiquity of the place; it showed that at least 20 settlements were buried here by successive layers of débris. Systematic work, on behalf of the American Schools of Oriental Research and the University Museum of the University of Pennsylvania, commenced in 1930 and it has been going on ever since. The first two seasons were under my personal direction and they saw the removal of Levels 1-8. When I returned to my regular work at the University of Pennsylvania, in 1932, Mr. Charles Bache took up the task, progressing as far as Level 12. Last season I was able to get back to the field and to carry the excavation down to Level 16, in addition to making trial soundings on the slope where six still older strata were probed.

Throughout these campaigns Gawra has more than lived up to its name, getting progressively richer and more significant as century after century was being sliced off with the removal of each additional level. The results obtained in previous seasons are too well known to require more than a passing mention. In our downward course through the ages we reached, with Level 6, the time which is recognized as the Early Dynastic Period: a contemporary of the Royal Tombs at Ur and the early dynasties of Sumer and Egypt. A few feet below was the level which coincided with the beginning of recorded history, marked by the invention of writing. Another few feet brought us across the border that separates history from prehistory. In Gawra 8 we came on a late prehistoric city which yielded, nevertheless, convincing proof of civilized life: stately temples and evidence of a purposeful but leisurely existence. Below the remains of that period were discovered archaic tombs rich in objects of gold and electrum and wonderfully ground obsidian vessels. In Level 11-A was found the Round House, a temple-citadel of unique design. Gawra 12 proved to belong to the period of the so-called Painted Pottery Peoples. Its buildings were regular and well constructed, although the



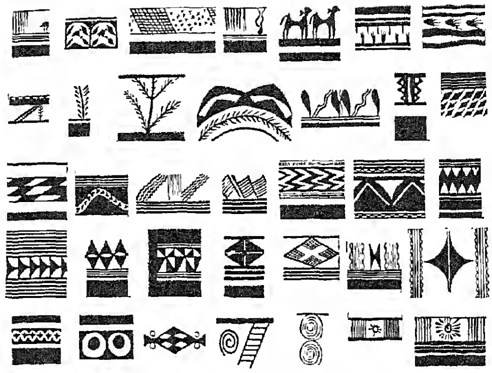

A plan of the Northern Temple shown above. Its dimensions were about 42 by 31 feet

architecture could not be termed inspired. Apparently mankind had learned the art of building only a short time before. At that, the structures of Level 12 were among the earliest buildings of any kind known to archeology.

By that time we had advanced about 1000 years beyond the beginning of history. Definite dates are possible only where there are written records to check them. But since writing is known to have been created toward the end of the 4th Millennium B.C., any occupation earlier than that time must be anchored by means of merely relative dating. We can be sure that Level 11 is older than 10 and later than 12. Hence the inestimable value of Tepe Gawra which contains so many prehistoric strata. Absolute figures have to be avoided in these circumstances. On general considerations, however, Gawra 13 may be placed towards the end of the 5th Millennium B.C.

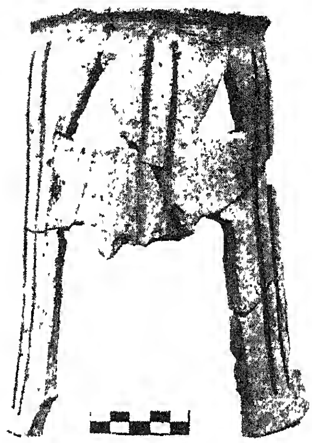
OFFHAND one would assume that the civilization of Gawra 13 was more primitive and inchoate than that of the immediately succeeding levels. That is what we thought, mindful of the normal curve of human progress. But we were due for a stunning shock, and the experience is unforgettable because it echoes, of necessity, the experiences of early mankind. Those inhabitants of Level 13 were neither primitive nor normal; they were an abnormally gifted and wonderfully balanced people. And they left ample evidence of their achievements in more than one aspect of communal life.

Pottery constitutes almost invariably the most articulate message transmitted to us by an archaic civilization. We were prepared therefore, in a way, for competent ceramic work in Gawra 13. But it was to prove more than that. The shapes were unusually graceful and the decoration was always appropriate to the particular shape in question. Furthermore, the designs betrayed that delicacy of touch and wealth of imagination which marks the difference between real talent and mere skill. The same could be said of the stamp seals cut in stones of various degrees of hardness. The seal cutter may not have achieved the perfect naturalistic representations of animals which were to appear many centuries later, but he had the ability to impart to his scenes a sense of lively and graceful movement that is absent from the best Sumerian work of the early 3rd Millennium B.C. The jeweler had learned to cut his lapis and carnelian, to grind his obsidian and fashion his gold, the oldest datable gold known, into beads of varying shapes. Music enjoyed a tradition of long standing. The instruments which have been recovered are made of bone, and they consist of single tubes, not unlike the modern



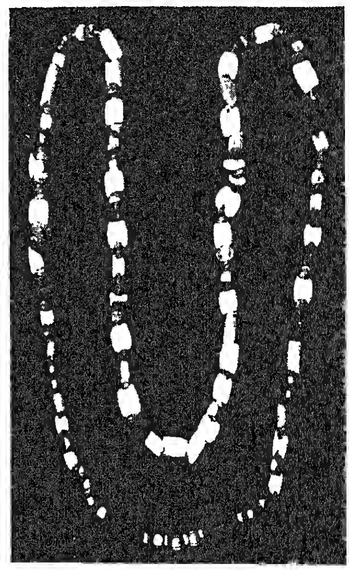
Selected pottery motives from Gawra 13. The decoration represented real talent and not mere skill

An engraved seal stamp from Gawra 13. The seal cutter knew how to impart a feeling of movement that is not found in much more recent artistic work



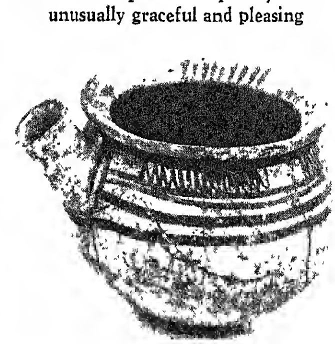
An incense burner from Gawra 13

*Below:* Bone musical instruments



Beads of gold, lapis, carnelian, obsidian, and shell, from late Gawra 13. The jeweler had learned how to cut and fashion his materials

A painted kettle from late Gawra 13. The shapes of the pottery were unusually graceful and pleasing



flutes, or of twin-tubes similar to the shepherd's pipes of today. One such specimen, happily complete, was found in the burial of a child less than ten years old, an ardent and nameless music lover who had played his tunes more than 4000 years before the musical affectations of a Nero were to become proverbial. From these and countless other little details, too numerous and specialized to be mentioned here, we obtained a fair idea of the culture of Gawra 13.

But perhaps the crowning glory of the period was reflected in its architecture. Again it is necessary to emphasize that very few settlements of comparable antiquity had ever been touched by the spade of the archeologist, none linked so clearly with what had lain above and what was to come up below. Our knowledge of contemporary buildings and building methods had been scant indeed.

A painted terra-cotta figurine of the "mother goddess" type, from a cut in the eastern slope of Gawra. It came from the earliest settlements

Flimsy mud hovels were about all that could be expected at this stage.

Instead, Gawra 13 presented us with the type of architecture that would have been a revelation at a far more recent date. Some of its details were not to be duplicated for centuries, and the harmonious arrangement of those details into complete buildings and building compounds was not to be paralleled for thousands of years. We were fortunate enough to uncover not mere secular buildings, but temples; a group of three forming an acropolis of unusual appeal. All these temples embodied certain architectural building principles common to this amazing level. But each temple had also a design, a character, and an individuality peculiarly its own.

A good example is furnished by the Northern Temple, the smallest of the three. Its dimensions are roughly 42 by 31 feet. The design may be said to revolve around a central Cult Chamber, which opens into four side rooms, two at each end. The walls of the Cult Chamber were subdivided by four piers, each of which had double pilasters, so that recessed niches were formed between the piers. The principal inside corners had corner piers with quarter pilasters, and the same was true of the main outside niche in the front wall. The combined decorative effect is easy to appreciate. The underlying functional purpose of the piers and pilasters, namely, that of supporting the roof and possible upper structures, is equally apparent.

The other two temples, the Central and the Eastern, differed from the Northern Temple in many respects. They were larger and differently designed. Moreover, they were painted on the inside in bright solid red and on the outside they were covered with a thick layer of white plaster. But all three are examples of monumental architecture, the oldest remains of that type which archeology has yet brought to light. All three had their piers and pilasters and niches, and all faced upon the Main Court which they helped to make a truly inspiring sight. Lastly, the acropolis as a whole betrays the same daring in conception and sureness in execution, the same spirit of inventiveness and freedom from the shackles of tradition; in short, the same harmony of shape and material and decoration that we have seen in the work of the contemporary potter and seal cutter. Yes, those people of remote prehistoric times were not at all primitive, but rather a singularly gifted and active group. And the prodigious effort which the construction of an acropolis presupposes testifies to a high degree of communal organization and to an advanced stage of religious development.

OF the finds from lower levels I shall single out but one. In Stratum 16, the lowest reached by us in regular excavation, we found an explanation for the remarkable glaze-like finish that is present on some of the earliest known examples of painted pottery. In this occupation was discovered an irregular building with a circular shaft in one corner. That shaft proved to lead to underground corridors which opened into chambers filled with ashes and fused clay. Here was obviously the kind of closed kiln, the earliest known so far, which enabled the potter to maintain the necessary control over his furnace and to obtain the temperatures desired in his ceramic art. Indirect firing did the rest.

What was the total depth of the deposits which had accumulated at Tepe Gawra until the site became too tall for practical occupation? In other words, how many occupations or levels had the mound buried? The lowest stratum reached from the top is now the 16th. But we can go a bit further in answering the above question. On the eastern slope we cleared a large section of the site and reached virgin soil 30 feet below the present level of the plain. Six levels were discovered in this cut, with pottery, terra-cottas, and ornaments of the so-called Tell Halaf period. Now the topmost one of those six settlements is older than our Level 16. The gap may be closed when excavators have descended to the 17th level, but then it may not be. It follows that Tepe Gawra contained originally, in its 70 feet above the plain and in its 30 feet below, not less than 23 settlements. The place has not revealed to us its entire history by any means. Much labor still remains to be done.

But all the work accomplished to date and the effort that lies ahead can be translated into building units in the general structure of archeology. They will be fitted and placed in position in due time. One set, however, is bound to loom large in the future. The rich and well-balanced civilization of Gawra 13, representing as it does one of the earliest and hitherto least known stages of early mankind, cannot but constitute a cornerstone in our restored edifice of ancient times.

A closed pottery kiln with shaft leading to underground chambers. This old building is from Level 16, the lowest of the 23 levels thus far excavated

# OUR POINT OF VIEW

## Is Our Age Lop-Sided?

DURING the present troubled times all over the world, many thinkers have felt that mankind has indeed reached a cross-roads and that, for the duration of our lives at least, world conditions are not likely again to reach the static calm that middle-aged persons recall with pleasure. Security is the one thing the individual instinctively seeks, and today it is the thing least apparent in the immediate future. People who think tell one another they feel as though they were sitting on the edge of a volcano, and the whole world suffers from an anxiety complex.

Whatever the immediate causes of this existing state of mind and nerves—whether the aftermath of a great war or the ushering in of social changes that already were on the way—science, in the final analysis, is the real cause that lies back of all such causes. It is *science* which, in four short centuries, but mainly in one, has so greatly accelerated the normal course of human events that present-day observers of those same events scarcely can keep abreast of them. So rapid is the tempo that there is no wonder that breathless, exhausted people cry for a vacation from further scientific advance lest the tempo turn into so rapid a crescendo that the whole machinery will burst from its own gaining velocity.

What man has done thus far in this age of science is essentially to discover and release a host of new raw forces into the world and then leave them to react, largely unguided, on each other. All these forces are the parts of a vast picture puzzle which has not yet been put together and unified. They lie heaped up in disorderly confusion.

Possibly, therefore, it is time to call a halt on the discovery of new forces such as the too-much-hoped-for energy within the atom (thousands of times more potent for good or evil than that in TNT), until man has grown up and learned to control himself. One sometimes catches oneself in imagination conducting Aristotle, Leonardo, Galileo and, say, Benjamin Franklin—all keenly interested in science and invention—about the world and proudly showing off to these astonished men our modern mechanical attainments, our uses of electricity, our airplanes, our knowledge of matter and perhaps a high-speed modern printing press. At the end of the tour one eagerly awaits the final summing up by these men—their uncontrolled enthusiasms. Then comes the report: "You moderns seem to have accomplished wonders in the control of nature but, tell us, have you yet made much headway in a thing that is still more important—the control of yourselves?" And then our heads droop as we reply a bit sadly, "No, we haven't yet, as a whole, even learned to think: we've probably spent too much time trying to make ourselves comfortable."

Perhaps it is time mankind began putting more of his time on sorting out that tangled picture puzzle, on arranging the whole—on learning to think.

## Engineers Barge In

ENGINEERING is an exact science. Politics is—let's not be too harsh—no science at all. How, then, shall the two become bedfellows? Engineers who encroach upon the sacred preserves of the politician would seem to be attempting the impossible. Yet some are on the point of doing so if we credit the report of Frank R. Innes, western editor of *Electrical World*, that a recent poll among engineers indicated a desire to take an active part in current matters of national interest.

Mr. Innes suggests immediately an investigation of the federal water power program. He is not concerned with the politics but rather with the hard engineering facts and the long-view economics of the program, for he would have engineers study markets for federal power, competition with existing utilities, the argument that water-power electricity is practically obsolete as compared with steam-generated power, aggravation of unemployment by construction of large power plants, the question of financing federal hydroelectric projects in the face of the fact that many of today's most efficient machines may be obsolete in five to ten years, and several other related subjects.

The schedule sounds too good to be true—too good to go through without being blocked. Politicians will not look kindly upon this effort to throw the cold light of scientific truth upon projects which they have, in the main, planned as gestures to hold the votes of "the folks back home." Yet such an impartial searching out of the truth is vitally needed lest we be handed, in return for our taxes, more white elephants such as the costly 'Quoddy experiment. Three million dollars were spent on that project before Congress stopped it by refusing more money. Did that august body see the light as a result of its own study or because of Dr. K. T. Compton's remarks as to the extreme costliness of 'Quoddy power as compared with steam-plant power? Frankly, we don't know, but . . .

If the engineers will keep right on barging in—splendid! It is a great responsibility they've shouldered but the results can be enormous. Let's hope they're not afraid of the politicians.

## *Antarctica*

BRITISHERS take a lugubrious sort of pride in their reputation for "muddling through." And well they might for the word "through" connotes completion, and that, after all, is the thing desired. But for a ponderous inertia, and mass indifference to vital current problems (rarely permitting discovery of the solution until far past the climactic moment) we of the United States take first place, with no runners up.

Britain, in her best muddling-through manner, has just made official, by Act of Parliament, her claims to certain parts of Antarctica explored by Britishers. Hers is a *fait accompli*. We, however, with a legitimate claim to other vast areas of the same great continent because of the explorations and long residence of American explorers—notably Admiral Byrd's two expeditions—haven't even talked of making our possession official by Act of Congress. Why not? The Antarctic is believed to have huge beds of coal which, in future years, may be needed and could be hauled out by some modern contrivance.

Is our failure to take the matter seriously just plain indifference? Is it cynicism? Knowing that present sources of coal won't be exhausted for 1000 to 5000 years, do our people simply shrug their shoulders, dubious of the continued existence of a race of human beings on earth? Are they so sure that the disasters of modern war will stop our muddling for good and all?

Perhaps. Yet our indifference does not become us and is short-sighted. We will need new sources of petroleum in the next few decades and there may be pools of it in the Antarctic which could be made available. We don't know; we're only saying: "for example." For whatever we may get from that cold region in future years, it is certainly worth the slight effort necessary to establish our claim. Let's overcome our inertia for once.

# TAILORED RADIO WAVES

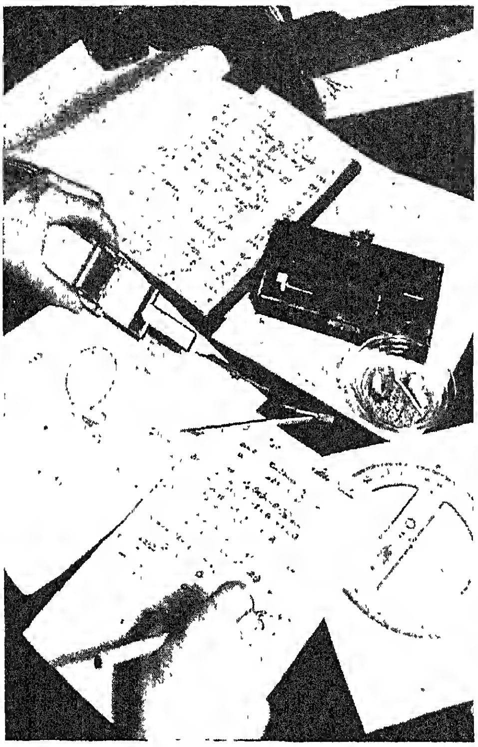
## Concentrating Broadcasting Service Where it Will be Most Effective . . . "Field Patterns" Determined by Design of Antenna System

By ALEXANDER MAXWELL*

IN physics class it was taught that radio waves travel in an ever expanding circle, like the ripples created when a pebble is tossed into still water. They do, when left to their own devices, but not being satisfied with anything as simple as that, engineers have devised ways to make the waves radiate in the form of a fan, a shamrock, a four-leaf clover, a spatula, a double watermelon or an airplane propeller. These are only a few examples of what are called field patterns that are determined by the design of the transmitter antennas. An engineer named Southworth went to the bottom of the subject, and when he came up he had over 60 possible patterns for two antenna tower installations; not stopping there he kept on until he had worked out the possibilities of all combinations up to 48 towers. The patterns were startling and glorious to behold, for they ranged from starfish to daisies and then ended in one long, lean design no wider than a highway and stretching out for thousands of miles. That seemed to be what he was seeking—virtually a wireless telephone line. It worked like a charm and is now in use for trans-oceanic service.

Broadcasting station engineers pricked up their ears at the news. Here was something that looked interesting, for radio reception conditions were unbearable in congested locations. Government regulations curtailed activity; competition was intense. In short, the time was ripe for any improvement which would relieve the situation. The early history of all enterprises is practically identical. There is a pioneering period, one of floundering expansion, sudden regulative interference, then things settle down to serious business. Radio was no exception.

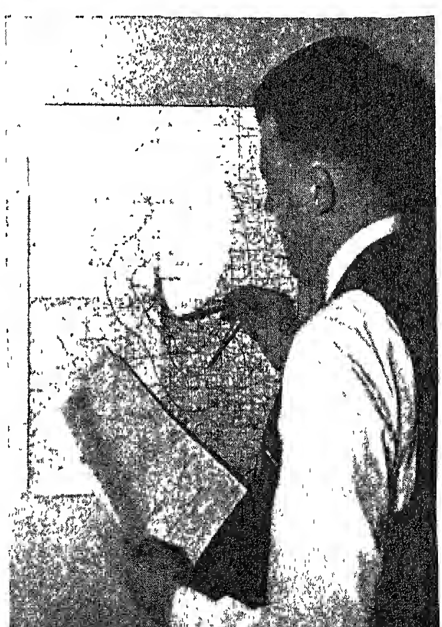
In 1920 the enterprising pioneers were already at work. It wasn't broadcasting then; it was fun, masquerading as experimental work. Existing commercial stations and amateurs both dabbled, and everybody had a good time. 8XK, the station of Frank Conrad in Pittsburgh, became the first commercial broadcaster under the call of KDKA. In 1923, broadcasting became popular and swept the nation by storm. Stations materialized over night, every able-bodied man who could read a blue print and handle a soldering iron built a radio receiving set. The thrill of hearing a voice a thousand miles away held most listeners spellbound. The favorite pastime became sitting in front of the radio, picking up one station after another and sending each a postcard. It was indeed the era of pioneering. It was new to broadcaster and listener alike; they both got a thrill out of it and everybody was happy. Pioneering, however, is always a transient stage and the end came rather abruptly.



**Months before construction starts on a new radio transmitter, the engineers start to solve problems of design. It frequently requires 15 pages of equations to compute the antenna system**

In 1927 the Government decreed that the situation had got out of control, so a department was created to regulate radio broadcasting. All licenses were called in, new wavelengths were assigned and maximum power was specified for each station. The assigned bands were classified as clear channel, regional, or locals, depending upon their purpose and coverage. Many, which could show no real reason for existing, were dropped from the list.

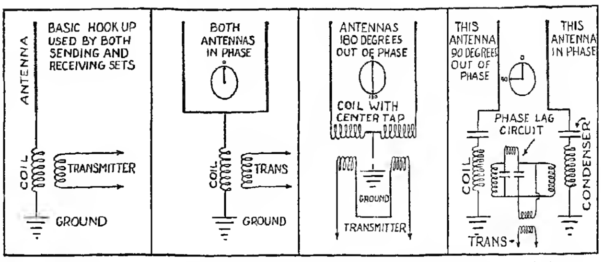
The problem was settled, as far as the Government was concerned. The stations were placed so that no two occupying the same wavelength were within conflicting distance of one another. This was 100 miles for locals and up to 700 for regionals; a clear channel sta-



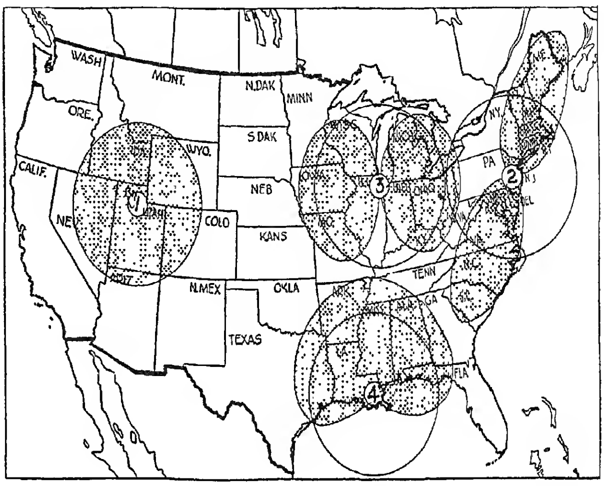
**Checking the results of tests against the computed field pattern, which seldom varies more than a mile or so from that found in practice**

*Amateur radio W9BRE

tion had its own wavelength all to itself. To make this system work out in practice many of the less prominent stations were granted daytime hours alone; others were permitted to use full power before sunset, but, for example, only one fifth as much in the evening. Station requirements were tightened and, to be permitted to use the air at all, the transmitter and program policy had to come up to rigid specifications.

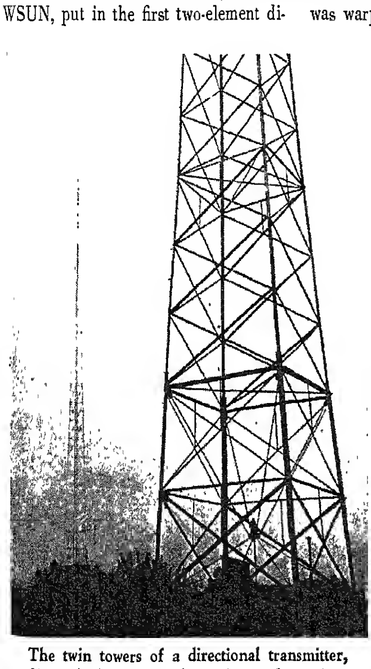



The basic circuit at the left above produces a circular field pattern as at 1, below. The twin antennas in phase produce pattern 2, while antennas 180 degrees out of phase give a pattern such as 3, below. If the systems are 90 degrees out of phase, as at the right above, the resulting pattern is like that at 4, below




WHILE the situation was decidedly improved, many station operators felt that they were not covering their territory as completely as they should. Suppose, for example, that it took 1000 watts consistently to put a satisfactory signal into a certain neighboring city, and the station was allowed to use only 500 watts. Increasing power was out of the question, for the station would then interfere with the others that shared the same wave. The only way out was to use a more efficient antenna, and so the engineers turned to the charts Southworth had prepared as the next logical step. They talked controlled radiation, plans were drawn on the table cloths in restaurants, and conventions and meetings were given over to discussion, but those who held the purse strings were still reluctant. Twenty thousand dollars was the very least it would cost to make the change. How did the hard-headed business men who directed the destinies of radio stations know that the idea would work? Let George do it first. If it works for him, then will be soon enough to talk.

And sure enough, George did it. A small and practically unknown station on the west coast of Florida, WFLA-WSUN, put in the first two-element directional broadcast antenna. Radio engineers and station executives alike figuratively held their breath; when tests were made, hundreds of receiveis were tuned in. It worked; the field pattern was no longer a perfect circle; it was warped into exactly the shape the engineer specified.



The twin towers of a directional transmitter, from which energy is directed toward two cities

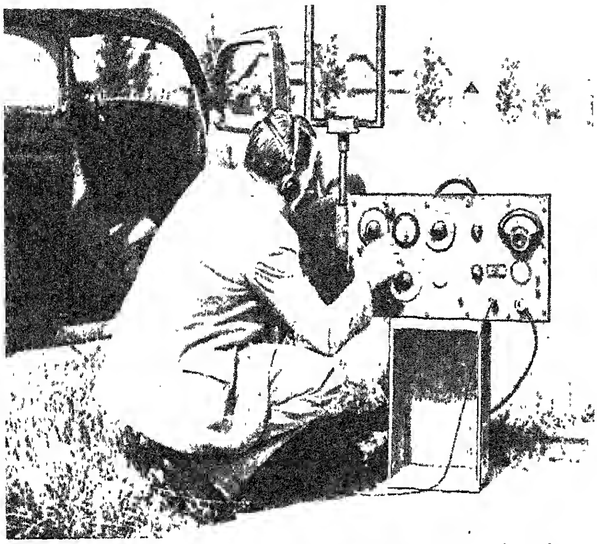
WIND, at Gary, Indiana, was the second station to try the experiment. The radio world at large was still not convinced that the idea was practical. In the fall of 1933 the re-designed station was ready to go on the air. The purpose of the directive system was to concentrate as much energy as possible in Chicago, and not waste it covering the uninhabited expanses of Lake Michigan. A second time the system worked. Engineers breathed easier and, with the consent of station owners, went to work to settle their own problems in the new way. Today there are 39 stations on the air having directive antennas, and more are being built.

How does it work? The principle of the directive antenna is simple and quite old. In fact, the first antenna ever used was directive. Hertz, father of radio, used a parabolic reflector, 'way back in the '80s, to direct his radio energy toward another antenna in a second parabolic reflector. That is the whole story. The placing of the reflector governs the shape of the field pattern.

Hertz, himself, discovered that a wire parallel to the antenna had the same effect as the reflector and was much easier to handle. Commercial systems using wire reflectors have been in use for a number of years, particularly in point-to-point transatlantic code stations.

THE basic circuit consists of an antenna, a coil of wire wound on a form, a ground connection, and either a transmitter or a receiver coupled to the coil. The diagram is quite familiar. It is the one used in your present radio, the one you struggled with 12 or 14 years ago when you built your first receiver; in fact, it is the same as is used in almost every wireless or radio set in the world, large or small, sending or receiving. Hertz used it, Marconi used it, and no one has ever found a better one. A station using this antenna system would radiate in all directions, like the expanding circle of ripples set up when a pebble is tossed into still water.

The extended or directed pattern has but slight resemblance to a circle. A



After a new station is placed in operation, the engineers spend weeks exploring with portable receivers such as this one, in order to check their calculations

station located in Philadelphia, for example, which with a single antenna would cover the territory bounded by a circle, could, by using a two-element system with both antennas in phase, cover the Atlantic Coast from New Brunswick to Georgia, and at the same time be completely inaudible out on the ocean or west of the mountains. With this system, the two antennas are connected to the top of the coil mentioned above. The antennas must both be exactly alike, and the lead-in wires must be the same length down to an inch. When both antennas are connected to the same end of the coil they are in phase. The distance between the antennas governs the length of the pattern. The non-directive antenna produces a circular field pattern. When the second antenna is connected the pattern lengthens out. With the towers spaced 3/8 of a wavelength apart, the pattern is one third longer than it is wide. Put the towers 5/8 wavelength apart and the pattern is just twice as long as it was originally. With this latter pattern tiny side lobes form. Pulling the towers still farther apart will lengthen these lobes and shorten the two long ones until a four-leaf clover results.

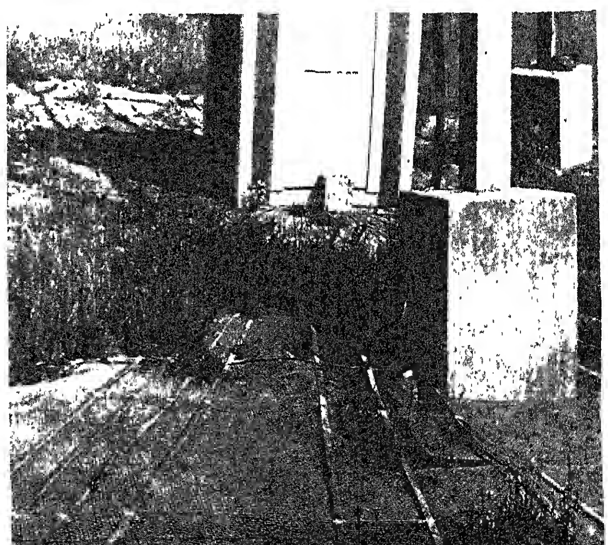
At first glance one is apt to get the impression that this is a fine way to get something for nothing. Such is not the case, for no matter how fantastic the final pattern, the total energy radiated is never greater than that which would go into a circular pattern from a non-directional antenna. What actually happens is that the energy is directed toward a pre-determined destination and suppressed elsewhere. Much good can come from turning the energy loose in New England, while the results of catering to the Atlantic Ocean are dubious.

The next complication which arises in the design of odd-shaped field patterns involves antennas which are out of phase. Alternating current, of which radio energy is composed, is first positive, then negative. In the house-lighting current these changes take place rather slowly, usually only 60 times a second, so we call it 60-cycle current. In radio the alternations are much faster, but the principle is the same. So, with an antenna system that is 180 degrees out of phase, when one antenna is positive, the other is negative, and they are one half cycle apart. This sounds very complicated, but all that needs to be done is connect an antenna to each end of the aforementioned coil and the ground to the middle, as shown on the preceding page.

Complexity begins and the engineers work for their money when one antenna is tuned to the desired wavelength, and the other is deliberately thrown a quarter cycle out of phase by means of a phase-lag circuit. The resulting field pattern is a fan, or it can be made into a heart or a spade by varying the tower spacing, and is used where it is intended to concentrate all energy in one hemisphere and suppress it completely in the other. The *pièce de résistance* of the phase-lag circuit is a choke coil. A choke coil causes an alternating current to lag; a condenser makes it lead. By juggling the chokes and condensers, the exact amount of lag desired is obtained. This need not be 90 degrees; it can be anywhere from 1 to 359, depending upon the pattern desired.

One engineer worked for months designing a four-element antenna system. His problem was exceptionally complex, for the station was located at the base of a peninsula. One narrow beam was to cover the tongue of land, and a wide fan was to cover three important cities on the mainland. In addition, a local station was to use one of the four towers simultaneously on a higher frequency, operating non-directionally. The engineer designed the station, built it, tuned it in mid-winter, with the temperature below zero and the snow up to his armpits, and when at last the job was completed and the station working, he threw up his hands and said, "I don't know why it works but it does."

The actual building of a station is the least of an engineer's worries. Months before the construction starts he must make his plans. A map is drawn showing the present primary service area. If these figures are not available, or the



A good ground is as essential as a well designed antenna system. This one is composed of wire screening and copper strips, with all of the joints soldered

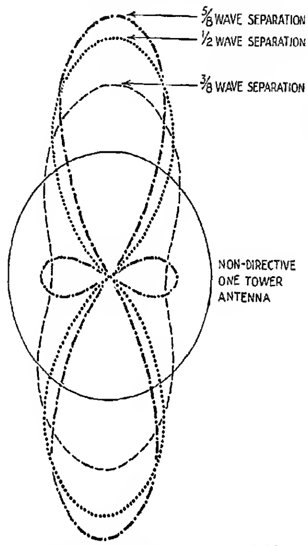
station is new, a test transmitter must be erected and the service measured in the field. This task alone takes two or three weeks. When the map is made, if the area covered does not include all the points desired, a directive field pattern is selected which will warp the energy into the proper shape.

The patterns are available in printed form, but each station is an individual case, and all the details must be worked out carefully. A very slight error is often enough to throw the whole array out of balance. To make certain, the formulas compiled by Southworth are fitted to the case and then worked out. Fifteen pages of equations are not uncommon in the figuring of a single station. Balancing this against an expenditure which may top 50,000 dollars, the effort is well worth while. So accurate are the equations that it is possible to know the exact size and shape of the field pattern long before the station goes on the air. One engineer makes a practice of deliberately underestimating the anticipated coverage in his first report, so when the actual range of the station is measured it is consistently ten miles more than figured. This pleases the owners.

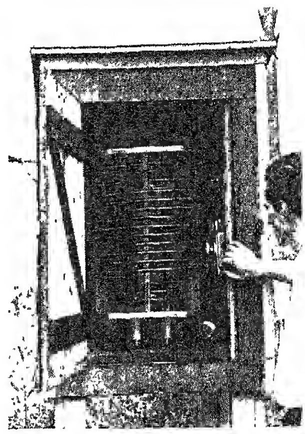
THE present antennas themselves are another contradiction to accepted practice of a decade ago. At that time text books went to great length expostulating upon the relative merits of the umbrella, the fan, and the flat-top, inverted L and the T. Today, save in isolated cases, they have all vanished. Gone, and in their place have risen needle-like slivers of steel, rising to great heights. No wires at all are used. The tower itself is the aerial. For the short-wave amateurs, police, and other stations, the situation is still further simplified. A 40-foot length of gas pipe stuck in the ground is all that is needed. Often it is not even insulated. How times have changed!

When one understands the circumstances, the reason for the change is obvious. A 1/8-wave antenna, which included most of them prior to eight years ago, emits a signal which rises high above the earth, and carries only a short distance. As the signal goes aloft at a steep angle it strikes the Heaviside layer and is reflected back to the earth. Thus there are two waves to consider—the ground wave and the sky wave. As the Heaviside layer of ionized gas is not always at the same level, the variations cause the sky wave to fluctuate in intensity. When a receiver is tuned in, the volume of the signal rises and falls, often disappearing completely.

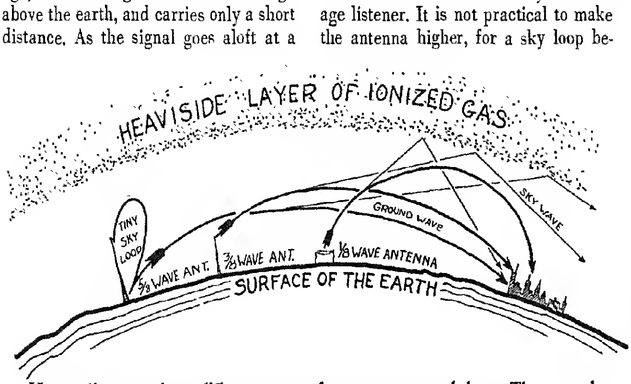
By raising the height of the tower to 3/8 wavelength, the signal hugs the ground more and covers a greater surface area for the same power. Making the tower 5/8 wavelength high, which amounts to six or seven hundred feet, the signal skims low along the earth and reaches out almost twice as far as the old flat top. At this point the upward angle is so flat that the sky wave has a long distance to go before reaching the Heaviside layer, and when it does bounce back to earth it is so far beyond the effective range of the station that reception becomes merely a freak and is treated as such by the average listener. It is not practical to make the antenna higher, for a sky loop begins to form. At a full wavelength in height, the entire signal shoots upward.




**The broken lines show how the field pattern from a twin antenna changes as the towers are moved**



**The antenna tuning inductance is, in modern transmitters, frequently located in a shed near the antennas, often far from other equipment**




**How radio waves from different types of antenna systems behave. The ground wave is most important to broadcasting. See complete explanation in the text**

At the present time no broadcasting station uses more than four antennas. Point-to-point stations, both phone and telegraph, however, have found an array of multiple antennas to be both economical and advantageous. A typical radio-telephone station consists of a double row of vertical antennas, carefully spaced and situated so that their broadside is "aimed" directly toward the destination. Each pair of antennas is called a couplet and they are so connected as to be 90 degrees out of phase. In reality they are only a modern version of the old antenna with its reflector which Hertz used almost 50 years ago. Twenty-four couplets make the standard array—a total of forty-eight antennas. This combination produces a beam which is compressed into a pencil of energy, placing the full signal at the receiving end, and is inaudible a few miles on either side. It is practically a telephone line without wires. By using it on the eastern coast of the United States, five kilowatts places a strong signal in England. By the conventional non-directional method it would take 130 kilowatts to do the same work and the phone message could be picked up just as easily in San Francisco.

Radio beacons on shipping lanes, and radio range systems on airlines are also modified forms of arrays.

So, by scientific use of the power available, the broadcasting stations which felt they were being discriminated against ten years ago are now in a position to offer better service than was then possible by the best. Interference is almost a thing of the past and, by careful planning, a number of channels have been made available for new stations—all because broadcasting has ceased to be broadcast and is now a scientific distribution of radio energy, to serve the most in the best way possible.

# THE NEW MARTIAN PUZZLE

## Mars' Current Apparition Reveals to Astronomers a Remarkable Phenomenon . . . Unprecedented Clearing in the Planet's Atmosphere . . . Signifying What?

By HENRY NORRIS RUSSELL, Ph.D.

Chairman of the Department of Astronomy and Director of the Observatory at Princeton University Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington. President of the American Astronomical Society

MARS has recently been more favorably situated for observation than for a dozen years past. When the earth, in its "stern chase" around the sun, caught up with him, it found him in the part of his orbit nearest the sun, so that the distance at opposition was not far from its smallest possible value. In consequence, the planet appeared unusually bright, decidedly surpassing Jupiter, and was the most prominent object in the midnight sky, although he was far south of the equator, in the head of Scorpio.

With the telescope, he showed a disk large enough to permit the recognition of abundant detail, though his low altitude at northern stations seriously increased the optical unsteadiness of the air which is known as "bad seeing." Only one report of this season's observations has yet come to hand; but this is of unusual interest. Dr. E. C. Slipher at the Lowell Observatory has secured photographs of the planet, taken with blue light, which show conspicuous surface detail. To understand the full significance of this, we must recall the conditions which affect planetary photography in general, and that of Mars in particular.

THE planets are so small, in proportion to their distances from us, that their telescopic images, even with large instruments, are tiny. Mars, for example, is 4200 miles in diameter. A distance of 38,000,000 miles—which is not far from the nearest possible—is 9000 times as great. Hence the image of the planet produced by an objective of 30 feet focal length is only one millimeter in diameter. A visual refractor has a rather small focal ratio—about f/15 in the ordinary notation used by photographers. To get a good exposure in a short time with such an instrument, one must use a fast plate. Fast plates—even the best of them—have none too fine a grain, and the small direct image of the planet cannot bear much enlargement. It is possible to do better by introducing, at a moderate distance in front of the plate, a negative lens combination, which enlarges the focal image—at the obvious cost of increased exposure time. In perfectly steady air, this would be no great loss, for the guiding of the telescope could be arranged for. But the air is never perfectly steady and, in a prolonged exposure, the dancing of the image will blur the picture. Too great an enlargement, with too long an exposure, is therefore harmful; but experience shows that a moderate enlargement—something like four or five times—gives the best results.

To make the best of the moments of good seeing, the observer customarily secures dozens of exposures on one plate—moving the telescope so that the successive images of the planet fall well clear of one another. Many of the images on such a plate will be blurred, owing to bad atmospheric conditions during the few seconds of exposure; but these can be ignored in favor of the few for which the conditions were better, and the images sharper.

The visual observer has here a great advantage, for the photographer is necessarily "going it blind," and trusting to good luck, while the trained eye can take advantage of single seconds of steadiness, as often as they occur. Nevertheless, the selected good exposures from a long series suffice to show a remarkable amount of detail, and record it permanently and impartially.

There is a remarkable difference, however, in the nature of the detail on different bodies. This has long been known by direct visual observation. The hard, black-and-white details of the moon's surface are more conspicuous and more contrasty than those upon Jupiter, and these, again, are much more prominent than most of the markings on Mars, which, except for the polar caps, are weak half-tones, with little contrast, and much harder to see definitely. Photography, as might be expected, tells the same story. Magnificent photographs of the moon, showing a wealth of detail, are easy to get (with a large telescope, of course). Under good seeing conditions, the surface markings of Jupiter photograph strongly, and, with appropriate photographic treatment, display more contrast than to the eye directly. But Mars again is a more difficult object. The planet's disk, even at best, is so small that the finest details, such as can be seen visually at the steadiest moments, are lost in the grain of the plate. Less difficult markings are definitely recorded—as may be clearly proved by comparison of the good images secured on a single plate—but the effects of plate-grain and of bad seeing smooth them out—very slightly in absolute amount, but enough to make it impossible to decide, from the photographs, whether they are as sharp and clear-cut as some visual observers see them.

BUT the photographs tell us other things which the eye fails to reveal. With the aid of color filters, and of the great variety of plate-types now available, we can work with light of very different colors; and, indeed, with infra-red and ultra-violet rays which lie beyond the range of ordinary vision.

Tried on the moon, this method tells us little that is new—though Professor Wood, many years ago, found certain spots on the surface which photographed very dark in ultra-violet light, and in this alone, and showed that terrestrial rocks thinly stained with sulfur behaved in the same way.

Mars, however, gives amazingly different pictures with light of different colors. With deep red light the large surface markings show strongly, with much more contrast than to the eye. With yellow light the contrast is less, with green light the details become very faint and, with blue and violet light, the permanent markings are usually quite invisible. Diffuse and irregular markings, however, appear in the blue photographs, but change from night to night—though the agreement of exposures taken on the same evening shows that they were really there at that time.

The polar caps are an exception. They are well shown in the red and yellow, but are often larger and more conspicuous in the blue.

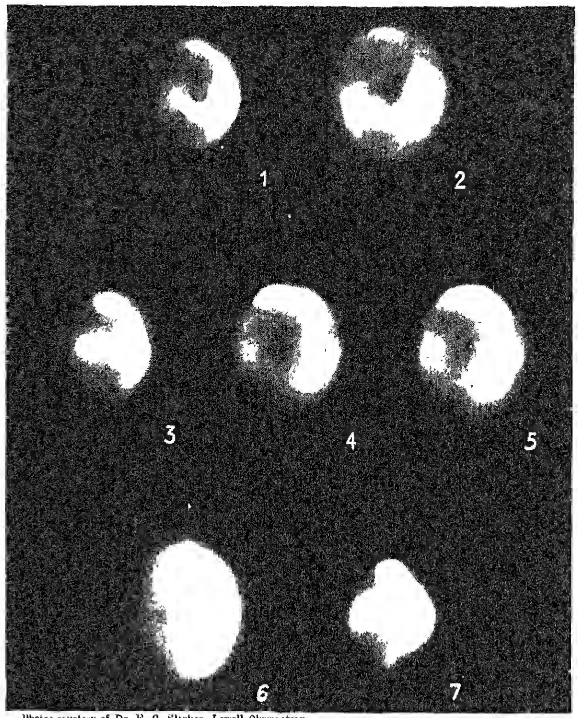
There can be no doubt about the main lines of interpretation of these facts. Permanent markings must belong

to the planet's surface—as do also those which show slow seasonal changes, like the polar caps. Fugitive markings, which are a thousand miles across one day and gone the next, must arise in the planet's atmosphere, and be similar to clouds or haze. Normal clouds, which are white, reflect light of all colors about equally well, and should appear with yellow light. Such objects are occasionally observed on Mars; but most of the markings show only in the blue, and must be of the nature of bluish haze. The extension of the polar caps on the blue photographs can be naturally explained by haze surrounding the snow, the latter alone being observable with red light.

But the disappearance of the surface markings on the blue photographs is less simple—there are two possibilities at least. One is that the actual colors of the reddish surface of the planet, and the greenish-gray markings on it, are such that, in red light, the first is much brighter than the second, while, in blue light, the red has lost most of its brightness and little contrast remains. The other is that the atmosphere of Mars, though transparent to red light and fairly so to yellow, is very thick and hazy to blue light, and hence obscures the surface details.

NO definite decision between these alternatives has hitherto been possible. But Dr. Slipher's observations of the present year are conclusive. On May 20 and 21, the Syrtis Major—one of the most prominent markings shown in the drawing on page 132—was near the center of the disk. Photographs made with blue light show it conspicuously, so that, as Dr. Slipher remarks, "were one not aware of what spectral region was utilized in making the photographs, he might easily mistake them for ordinary yellow images of the planet." On other blue photographs made on May 23 and 24 the Syrtis is seen, though less distinctly; but on photographs taken on April 20, with the same telescope and color screen and with plates of the same emulsion, no recognizable trace of the Syrtis appears—while the usual hazy patches are conspicuous. Visual observations, and photographs with yellow and red light, show that no notable change had occurred in the dark markings themselves, and there is no room for doubt that, in the interval of a month, the atmosphere of Mars changed from its normal blue-hazy state to unprecedented clearness.

It may be concluded then, that, if we could see the unobscured surface of Mars, the markings upon it could easily be photographed at any time with blue light—though probably with less contrast than in the yellow and red. The atmospheric haze, which is usually pierced only by yellow and red light,




Photos courtesy of Dr E C. Slipher, Lowell Observatory

**Seven examples of photographs all of the same face of Mars, taken at Lowell Observatory. Photographs taken in yellow light (yellow filter) reveal the main surface features of the planet, as in Nos. 1 and 2, taken respectively April 20 and May 20, 1937. Ordinarily, however, those taken in blue light (blue filter) reveal only the polar disk: for example, No. 6, taken in 1926. This is because the waves of blue light, being shorter, do not penetrate atmospheric haze, just as on earth. However, on May 20 and 21 of the present year exceptional conditions existed on Mars, for even the blue short waves penetrated his atmosphere almost as well as the longer yellow ones, thus making possible Nos. 4 and 5, taken with blue filters. They clearly show the great dark area of Syrtis Major (see page 132). The reason for this exceptional condition is believed to have been an unusual clearing up of the Martian atmosphere. In the *Publications A.S.P.*, Slipher writes: "Our photographic record of the planet at Flagstaff maintained for many years fails to reveal a change quite so remarkable."**

**Thus the blue-light photographs show three distinct states of Mars' atmosphere: Nos. 3 and 7, extensive cloudiness; No. 6, no cloudiness but great opacity; Nos. 4 and 5, the most transparent condition yet noted by astronomers.**

reminds one of the haze-piercing value of red photographs in terrestrial aviation. But the opacity of the Martian atmosphere is greater than that of the earth's. Using the same spectral region, Slipher has photographed terrestrial landscapes "through an air path equivalent to several times the earth's homogeneous atmosphere" (that is, the amount of air between us and the zenith). It is very unlikely that there is actually a much greater quantity of atmosphere above a square mile on Mars than there is here. More probably, the Martian atmosphere is full of some sort of finely divided matter which is "capable of an amazing amount of scattering and absorption of the short wavelengths." What this stuff is we do not know; but we now know that at times most of it is cleared out of the Martian air. Slipher reports that, on previous occasions, the transparency for blue light has increased, though never in so striking a fashion as on this one.

What this haze is—or, at least, what it may be—and how it gets cleared off at times, are problems which may well interest the physicists and physical chemists—to whom we may look hopefully for a solution.

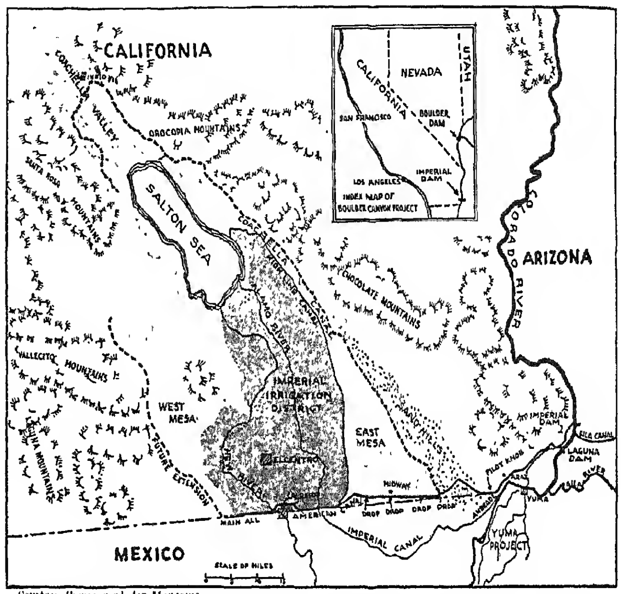
Of the reality of the canals, there can be no doubt. The writer, for example, saw some of the strongest ones, which are shown on page 132, when on a visit to Flagstaff last May, despite a night of poor seeing. Conditions were not good enough to show whether they were fine narrow lines; but their faintness, compared with the typical drawing, was obvious. It may be hoped that these few words of explanation may show why the drawings afford nevertheless a more appropriate and useful method of recording the observed facts than a more "realistic", though no more accurate, representation.—*Jamestown, Rhode Island, July 1, 1937.*

# FINISHING THE

## New Canal Replaces Old One that Goes Partly Through Mexico . . . Water for Two Rich Agricultural Valleys . . . A Monumental Undertaking

WORK on the All-American Canal is going forward so rapidly that the great 80-mile ditch and its appurtenant features will be ready to deliver irrigation water to the Imperial Valley in southeastern California some time during the first half of 1938. The waterway is being dug across a normally desert region that once formed the water bed of the prehistoric northern extension of the Gulf of California, as we know it today. Paradoxically, that far-flung section of the Gulf was transformed into a generally barren and arid region by the very river that is to be tapped to assure the continued agricultural productivity of soil that can be made amazingly fruitful by irrigation.

To understand the reasons for the All-American Canal, one must have some knowledge of the physical conditions of the basin in which the Imperial Irrigation District is located, of how the territory was transformed from an arm of the sea into a semi-tropical waste land, and, finally, made to blossom by man and to yield marketed crops having a current annual value of more than 50,000,000 dollars. The Salton Basin in which the Imperial Valley lies is located partly in Mexico and partly in the United States. When it was the upper continuation of the Gulf of California, its water surface had an expanse of around 2000 square miles, and the northernmost reach of that body was nearly 150 miles above the present northernmost limits of the Gulf of California.




Courtesy Compressed Air Magazine

Once part of the Gulf of California, the depression, Salton Sink, is over 300 feet below sea level at its deepest. Two rich farming valleys lie within its area

PROBABLY not less than 500 years ago, the Colorado River discharged into the ancient gulf in the vicinity of Yuma, Arizona, and therefore close to the existing international boundary. The river today discharges into the Gulf of California approximately 60 miles, by air line, farther southward. In the past, as now, the Colorado River dredged from its watershed annually an enormous quantity of soil and carried much of that material onward to its mouth where it gradually built a ceaselessly lengthening and widening fan-shaped delta. Even now, there is deposited on the delta each year an average of 170,000,000 cubic yards of silt—that is, as much as all the earth that was dug in excavating the Panama Canal. The apex of that delta is near Yuma, and widens out as its axis extends southward. That delta has a somewhat arched surface; and more or less upon that crest, like a drunken person, the river has staggered in its flood stages and frequently changed its course to a pronounced degree within the memory of the white man on this continent. This is understandable because the soil of the delta is soft, while the river is violent when in flood.

When in one of its recurrent capricious moods, the Colorado started building an arm of its delta directly outward from what was then the eastern shore of the gulf, and the river progressively extended that barrier until the opposite shore was reached—thus bisecting the gulf and isolating its northern area so as to create a vast land-locked lake. The strong sunshine characteristic of the region and very scanty annual rainfall led in time to the evaporation of most of the water in the basin, leaving in the end only the water that has been variously known since the close of the 18th Century as the Salton Sea or Salton Sink, which occupies the deepest part of the basin, in California. It is said that the lowest point in the bed of that body of water is 320 feet below the normal level of the Pacific Ocean.

Furthermore, the bed of the Colorado River is about 100 feet above sea level at the northern limits of the delta. Therefore, flood water overflowing the western bank of the delta has a descending slope of about 400 feet down which to rush toward the Salton Sink. According to Indian tradition, the Colorado has invaded and even filled the Sink on numerous occasions. Since 1900, the river has ruptured its banks and entered the basin several times—the flow once continuing for well-nigh a year. At that time, the excess flood water cut a path 1000 feet wide and as much as 80 feet deep as it surged onward to the Salton Sink and raised the level of that body of water nearly 73 feet.

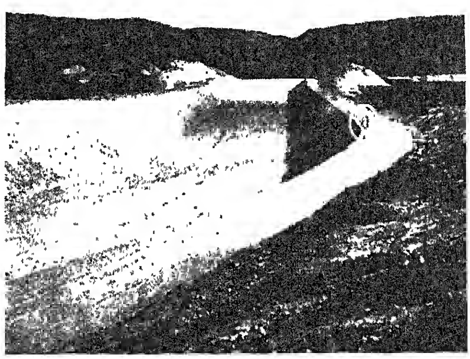
This peril has been an ever-present one since water was first deliberately let into the Imperial Valley early in 1901, primarily to irrigate the fertile but arid soil of that part of southeastern California. In the meanwhile, communities have developed upon the American area where now there is an aggregate of about 75,000 inhabitants; and of the total of 586,000 acres in the Imperial Irrigation District that are susceptible of cultivation, something more than 450,000 acres are actually being farmed. The American expanse of the entire basin, including the Coachella Valley and two potentially productive mesas, embraces close to 1,000,000 acres of land that can be irrigated, by gravity or pumpage, and made to yield rich returns under skillful handling. The growing season is virtually the entire year.

Since 1901, about 200,000 acres in the

# All-American Canal

By R. G. SKERRETT

Mexican part of the basin have been made productive by water from the old canal originally constructed to serve American farmers. To save money and to dodge obstacles reared by nature on American soil near the river, the first intake was dug in California a mile and a half above the international boundary, and from that point the canal was run southward and parallel with the Colorado until it soon met the old and dry channel of the Alamo River—one of the former courses by which the Colorado penetrated the basin. The use of the old water-bed obviated much expensive excavating but it led the canal by a devious path, 50 miles long, through Mexican territory before re-entering the United States. Not only that, but the promoters had to agree to give Mexican farmers in the region traversed half of the water whenever they desired it. In the beginning this did not cause friction, but the development of agriculture in the Mexican section of the delta entailed the withdrawal of increasing volumes of water, and this hampered and even imperiled the American farmers when the river was low.



Section of the new canal where it passes through barren desert. In the circle, the two men serve as a size-comparison

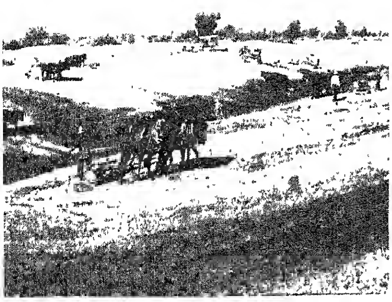
The flow of the Colorado at the canal intakes—there are now three—ranges from an average maximum of 200,000 second-feet to a minimum flow of 3000 second-feet at ordinary low stages. At times, the minimum flow has been a great deal less, and the maximum recorded flood has been of much larger volume than that just mentioned. The diminished water reaching the farms in the Imperial Irrigation District has on occasions imposed crop losses amounting to more than 5,000,000 dollars in the course of a single year. This situation explains some of the reasons for the construction of the All-American Canal, which is designed to deliver to southeastern California much more water than now can reach that area by way of the Imperial Canal; and the new canal is also counted upon to supply the neighboring Yuma Project with enough water to irrigate some tens of thousands of additional acres there. Not only will the canal be able to distribute a vitalizing flood of ample capacity to an immense agricultural area, adjacent to the lower basin of the Colorado River, but the water will be better suited to help the farmer than heretofore. That is to say, the Boulder Dam, the Parker Dam of the Colorado River Aqueduct, and the enormous desilting plant at the Imperial Dam will conjointly remove from the river water all but 20 percent of the silt that has been entering the Imperial Canal. The silt has clogged laterals and irrigating ditches and called for dredging which in recent years has necessitated an outlay of about 1,500,000 dollars annually. The intrusive silt, moreover, has overflowed on to nearby lands where it has damaged crops and impaired the agricultural value of the soil.

The three outstanding features of the All-American Canal Project are the diversion dam across the Colorado by which the river water will be impounded and directed into the headworks on the California side of the river; the immense desilting plant which will remove 70 percent of the solid matter in suspension in the water; and the canal, itself, which will have an initial length of 80 miles and deliver most of its water to the lands lying within the well-known Imperial Irrigation District, located to the east and south of the Salton Sink. Later on, the canal will deliver water to the Coachella Branch Canal. It will from the start supply the Yuma Project with 2000 second-feet of water. The Coachella Branch Canal, which will be 130 miles long, will draw, in time, 2300 second-feet of water from the main canal now under construction. The main canal, where widest throughout that part of it that connects with the headworks at the river, has sloping sides that assure a channel width of 160 feet at the bottom of the waterway and a water surface width of 232 feet when the water in the canal has a depth of 21 feet.

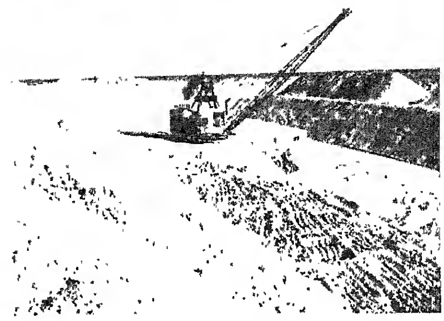
The canal, at the depth mentioned, will be capable of receiving and passing onward 15,000 cubic feet of water every second—five times the average volume of water flowing in the Colorado past Yuma at the minimum low-water stage. This flow can be maintained because of the capacity of Lake Mead and the regulatory facilities at Boulder Dam. The cross-section of the All-American Canal will be reduced in area as that waterway lengthens and gradually approaches its westernmost end in the vicinity of Signal Mountain, close to the international boundary and the far side of the Salton Basin.

The intake of the canal now building is about 15 miles upstream from Yuma and five miles above the Laguna Dam that diverts water to the Yuma Project. From the Imperial Dam southward to a short way below the Laguna Dam, the canal route follows closely the Colorado, and then turns westward and southward until it again nears the river at Pilot Knob, where it takes up its long run westward, generally paralleling the international boundary a little to the northward of that line. At Siphon Drop, on the Reservation division of the Yuma Project, the All-American Canal delivers water to the Yuma Canal. West of Pilot Knob, the new canal crosses a sand-hill region for 10½ miles—the obstructing area that caused the builders of the old Imperial Canal to keep to the eastward and to go south into Mexico.

In crossing the sand-hill area, broad cuts have been dug right through some of the hills to a depth of as much as 115 feet. The canal section through these hills will not be lined, although the flanks are being compacted; but measures are to be taken to check the blowing of sand into the canal. These measures may take various forms, such as vegetation grown on each side of the canal in a wide zone and irrigated from the canal; the spraying of the sand



In some sections, it was possible to do the necessary excavating for the canal with mule-drawn scoops. However, three tractors are shown assisting at this spot



Sand and gravel in the hotter desert sections called for the use of draglines operated by powerful engines. Here, the problem of drifting sands is a big factor

with crude oil; or the covering of the light sand of the neighboring dunes with coarse material excavated from the canal prism and too heavy to be disturbed by the winds.

The entire undertaking will involve the excavation of approximately 65,000,000 cubic yards of material, of which not more than 4 percent will be rock. The vast bulk of the digging has been done with gigantic power shovels and draglines, having bucket capacities of from 12 to 16 cubic yards. Bulldozers or plows of unusual power, and also large scrapers, have battled with the broken soil in smoothing it and distributing it to subscribe to the specified forms and surfaces. In short, all this work has gone forward on an unprecedented scale, and tremendous volumes of material have been thus disposed of in digging the canal, in modeling its floor and slopes, and in rearing the flanking berms that are further bulwarks against drifting sand.

PRIMARILY, the new canal on American soil will feed into the existing branch canals and laterals that have in the past obtained their water from the old Imperial Canal. But the present system will be extended and eventually other branches will be dug to distribute the water to areas not yet farmed but susceptible of irrigation either by gravity or pumpage.

None of the water flowing through the All-American Canal is intended for use in Mexico. At necessary points along the canal there are drops of 24, 26, and 51 feet where installations will be provided in time for the generation of hydro-electric energy ranging at the several points from 6200 to 24,000 kilovolt-amperes. These stations will lie westward of the sand hills and within a stretch of 25½ miles. The power will be put to a variety of services.

The Imperial Dam, by which the river water is to be diverted in the first place, is a concrete structure, now building, that will have a total length of about 2990 feet, exclusive of the rock-fill dike, about 470 feet long, at the Arizona end of the barrier. The central part of the dam will serve as an over-flow weir, which is to have a length of 1200 feet and a maximum height of 31 feet. This weir section is of the hollow concrete "floating" type, resting on a silt or sand foundation, and is to be partly filled with sand and gravel to give it the added deadweight necessary to assure its stability when resisting the thrust of the water arrested by it.

Probably the most spectacular feature of the headworks is the immense desilting plant consisting of six settling basins, arranged in pairs, with each basin 269 feet wide and 769 feet long. The silt-carrying water will be handled by 72 Door thickeners, having a spread of 125 feet each, which, by rotating slowly, will concentrate the suspended solid matter and cause it to sink. The plant will be counted upon to remove daily from the water from 50,000 to 70,000 tons of the suspended solids. The precipitated silt will then be sluiced away into the river below the dam. The desilted water after this treatment will be discharged into suitable channelways, connecting with the canal, that permit of complete flow regulation.

The total estimated cost of the present main canal and its appurtenant features is 38,500,000 dollars. The Government is to be reimbursed by the Imperial Irrigation District within a period of 40 years. The Government is well secured because the present value of the cultivated lands in the district is said to be 100,000,000 dollars, while the value of the crops shipped from the district is now steadily mounting and probably exceeds 50,000,000 dollars annually. The principal crops are alfalfa, cantaloupes, barley, milo maize, and small fruits; but many other products are being raised and will be grown in large quantities as soon as a sufficiency of irrigating water is assured. Each season approximately 30,000 carloads of cantaloupes and lettuce are sent to remote markets. The average annual crop yields of alfalfa are from seven to ten tons per acre—that is, a ton to a cutting; and an acre will produce 96 crates of cantaloupes. No wonder the Imperial Valley is looked upon as an amazing region, especially when its present fruitfulness is contrasted with its arid barrenness less than four decades ago.

The construction of the All-American Canal is under the direction of the United States Bureau of Reclamation; and when the undertaking is finished, it will mark the completion of the third and last of the main features of the Boulder Canyon Project.

# PRE-CERTIFIED LUMBER

By MARY BRANDEL HOPKINS

THE seemingly incredible feat of determining the grade and value of lumber which will be yielded by trees still standing in the forest has been achieved. In the future, if pruning is practiced scientifically, the extent of knots—the cause of irregularities in lumber—will be known definitely, and foresters will be able to "certify" in advance of cutting the grade of lumber to be obtained.

This ability to peer behind the veil of uncertainty is afforded the lumber industry by the United States Forest Products Laboratory at Madison, Wisconsin.

To the lumberman the beauty of low-branching evergreens framing a spacious lawn is only skin deep. When he gazes skyward 60 feet along the symmetrical trunk of a veteran white pine before encountering the first branch and says, "That tree is a beauty," he is speaking frankly in terms of lumber grades. He is looking under the skin. He is visualizing beneath the bark a sheath of "clear" or knot-free wood (increasingly hard to find), thickest at the tree base and gradually diminishing in thickness to a point about 15 feet below the green crown, where stubs of former branches show through the bark. He visions a second zone, inside the clear wood, characterized by "loose" black knots from dead branches, and still farther within he sees a core of "tight" knots remaining from branches that functioned when the tree was young, perhaps 350 years ago. His study reveals that the three and a half century old pine spent the first 100 years of its life—the period characterized by the dead and living branch zones—merely getting ready to produce the clear wood, whose growth consumed the next 250 years.

Above are typical unpruned forest trees, the future knots waiting to be enveloped in wood. The picture below shows how this takes place, to the detriment of clear lumber

MOTHER Nature's method of producing knot-free or clear wood is exceedingly slow. This has meant in the past that knotless wood was formed only in the outer layers of the branch-free lower part of tree trunks, and that from 200 to 500 years have been required to grow the clear lumber, cut principally from virgin growth timber, which is turned out of American sawmills today.

Man can not wait two to five centuries to renew the supply. He is impatient now to produce in second-growth forests, but in much less time, the same quality of timber found in the virgin forest. Yet by clearing, he has so changed forest conditions that future growth of knotless wood will be delayed a long time, because of the tendency for trees in more open places to assume the habits and appearance of widespreading, low-branching lawn trees, which contain only very knotty lumber.

In the virgin forest, side branches are removed through a snail's pace process called natural pruning—the result of gradual dying because of the exclusion of sunlight. With most of our native species that grow in fully stocked stands, the side branches are soon killed because they cannot endure shade. It is in trees in understocked areas, which do not receive shade on all sides and therefore retain indefinitely their green branches almost to the ground, that the "tight knot" or core develops most extensively.

Then, through a process of disintegration and decay frequently stretching out to exceed the lifetime of a man, the dead branches gradually weaken. Unable longer to bear their own weight, they drop to the ground, leaving irregular stubs that often cling to the trunk for 50 to 100 years before they are enveloped by new growth layers, much as a fence post is enveloped by layers of drifting sand. Later, when the trees are cut for lumber, these persistent branches appear as knots and cause serious degrade.

Only by pruning is it possible artificially to reduce the time that elapses during the formation of the knotty zones, and consequently their extent. The wound surface should be smooth and the cut made close to the trunk without tearing the bark.

Above is a sample of forest that has been pruned, and below is the kind of lumber that later results. As the years go on the new growth, all clear, will increase in width

# RADIUM—

# NATURE'S ODDEST CHILD

## Fruitless Early Expectations of Vast Power from Radium Atoms . . . Namombo Startled the White Men . . . Canada's Notable Contribution to Healing

By JOHN A. MALONEY
The Museum of Science and Industry, Chicago

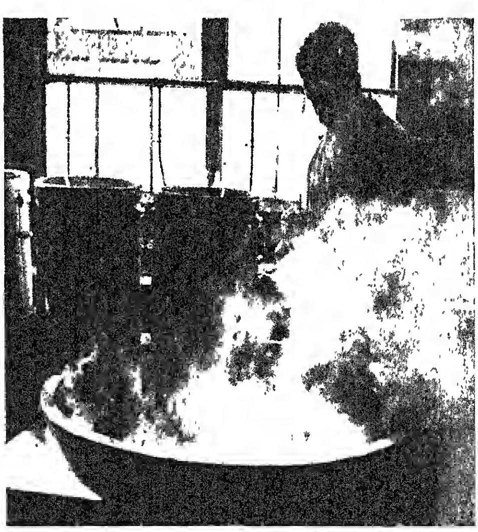
*(In Four Parts—Part Three)*

THE discovery of radium and the phenomenon of radio-activity turned the course of history for 20th Century physics. With its discovery came the knowledge that the atoms of certain heavy elements were not permanently stable but broke up with explosive violence. The inner structure of the atom, which had defied the mind of man since the days of the atomists in ancient Greece, the discovery of isotopic elements—elements identical in their physical and chemical make-up but differing in their atomic weights—these, and many other secrets of matter were solved by the discovery of radium.

Men were excited about the possibilities of this new substance. The energy that it gave off was staggering to the imagination. It was natural that the question should arise as to how this energy could be harnessed and put to work. Flannery and the others thrilled with the possibilities. Were not such eminent physicists as Sir Ernest Rutherford writing essays on harnessing the energy of radium and its future as a source of power? All of them realized that what was needed was a catalyser that would speed up the rate of disintegration of radium so that, instead of dissipating half of its energy in 1690 years, its power could be drawn off to turn a dynamo or push a piston in an instant. It may appear now that they were anticipating and were far ahead of their times.

To conclude our story of American efforts to gain a foothold in the radium market, we must shift our scene again —this time to a sweltering jungle near Elizabethville, in the Belgian Congo. The year is 1919. Dr. Jan Schoep and his expedition of Dutch scientists are laboriously making their way through the wilderness. Suddenly a painful scream that is undoubtedly human rings out through the jungle. In a few minutes the party came upon a lion mauling a native boy. The lion was shot and Dr. Schoep found that the boy's leg was broken and his whole body was horribly scratched. While Schoep set the leg, a runner was sent back to the nearest village to locate the boy's people.

His father arrived on the scene and escorted the party back to the village. Dr. Schoep recognized the father as Namombo, a powerful tribal chieftain in that vicinity. The chief thanked the doctor and his party and offered them gifts. When these formalities were completed, Namombo startled and horrified the white men by ordering his assistants to remove the bandages and splints from the boy, and to encase his leg in mud, plastering the open wounds with thick, oozy poultices. To men who were trained in modern methods of healing, such a procedure could be only an invitation to hordes of bacteria and a quick case of infection. They vainly protested against this savage treatment. But Namombo asked them to wait for a few days and see the results. In three days the mud casing was removed and, to the astonishment of Schoep's party, the boy's wounds were practically healed.



All Illustrations Associated Screen News, for Eldorado Gold Mines, Canada

**The first evaporation of barium radium liquor in the Curie process for separating radium from barium, at the Eldorado refinery. The starting liquor is about 500,000 parts barium to one of radium. Over 23 evaporation processes are required before the final salts, with 90 percent radium, are secured**

AFTER finishing their trip the party returned to Europe and Dr. Schoep presented the strange tale of an African mud-pack to the Royal Scientific Society of Brussels. An expedition was sent to the Congo to trade rifles and other commodities for samples of the mud. It did not take long after that to discover by chemical analysis that the mud which was being used by African natives to cure flesh wounds was also the richest radium-bearing deposit of pitchblende in the world. This discovery came just at the time when the radium industry in the United States was getting on its feet. But the enormous deposits in the Congo made it possible to cut the price of a gram of radium almost in half, and the American efforts at production ceased almost overnight.

Up to the time of the discovery of radium in the Congo, Flannery's organization had produced more than half of the world's stock of refined radium—a feat that is all the more remarkable when we remember that carnotite, unlike pitchblende, occurs as a binder between the grains of sand and involves the extraction of tons of worthless rock. To secure 1000 pounds of radium

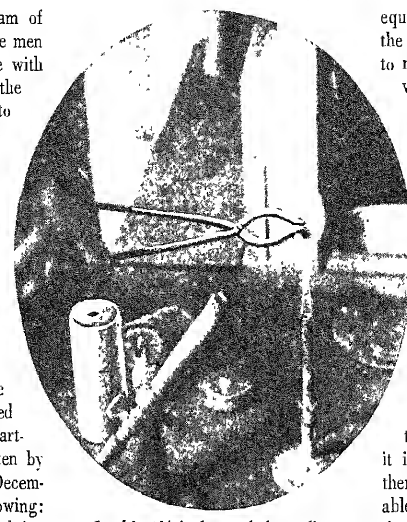
chloride that may contain a gram of radium, it was necessary for these men to treat 500 tons of milling ore with 300 tons of chemical, to use the power of 1000 tons of coal and to use more than 1000 tons of distilled water and the labor of 150 men for six months.

The exploitation of the pitchblende deposits of the Belgian Congo has been in the hands of a group known as the Union Minière du Haut Katanga. This organization has held practically a world monopoly on radium production (with some production in Czecho-Slovakia) since the cessation of operations in the United States. In a United States Department of Commerce bulletin written by Frank L. Hess and published on December 14, 1931, we find the following: "Particulars regarding the Belgian Congo deposits, owned by the Union Minière du Haut Katanga, are still heavily veiled in secrecy, and no word of reserves, or tenor of ore, is allowed to reach the public." Governmental figures for shipments of minerals from Belgian Congo include 944 metric tons of uranium ore in 1928 and 1296 metric tons in 1930. Sales of radium as given in the company's annual reports have been as follows:

| Year | Grams |
|---|---|
| 1923 | 20 |
| 1924 | 22 |
| 1925 | 20 |
| 1926 | 20 |
| 1927 | 26 |
| 1928 | 42 |
| 1929 | 60 |
| 1930 | 60 |

THAT the section of wild country around Great Bear Lake, on the Arctic Circle, is rich in mineral deposits, has been known to prospectors for at least 20 years. With the advent of the airplane as a tool of the prospector, the desire to devote closer attention to this region has grown by leaps and bounds. There is little reason to believe, however, that there will be a general exodus to this district simply because of the encouraging reports that have come in regarding rich deposits of silver, copper, and pitchblende. The trek across the United States in the days of '49 was a gay excursion in comparison with a trip to Great Bear Lake. The ice in the river and small bay breaks up sufficiently by July 1st to permit navigation, but the main body of the lake cannot be navigated until after July 15th. Night frosts set in again about August 15th, and by the end of September winter has asserted itself to such a degree that navigation is again an impossibility.

The end of this rainbow, with its pot of radium instead of gold, offers slightly more encouragement to the prospector who comes by the air route. Aircraft on skis can usually operate from waterways from December until early April. On Great Bear Lake itself pontoons must replace the skis from the break-up of the ice in July until the freeze-up in September. Darkness, at this gateway to the land of the midnight sun, seriously hampers winter flying.



**In this 1¼-inch vessel the radium from 20 tons of ore approaches final concentration stage. The final work is done by a physicist, who is protected by rubber gloves and lead shield. At left is a lead cartridge in which tiny tubes of radium are shipped. Total world's production of radium to date is 2½ pounds, worth 22,500,000 dollars**

Taking it for granted that even these conditions will not deter those rich enough in the world's goods from equipping themselves for travel by air, the Canadian government takes occasion to mingle a few words of friendly advice with those of welcome. Read this, from a recent bulletin describing the region and issued by the Geological Survey of Canada: "Parties entering should not depend in getting supplies of any kind at Great Bear Lake. Natives or dogs are probably not procurable at the lake. The trading posts carry limited supplies but cannot meet large, unusual demands. In March temperatures below 50 degrees and stormy weather are probable."

**Radium-barium crystals produced during the final stages of the Curie fractional crystallization processes in the Eldorado refinery at Port Hope, Canada. In this flask is one gram of radium valued at 30,000 dollars. Radium is seldom reduced to metallic form: it oxidizes. It is left as a salt—usually sulfate**

In a subsequent report we are told that some timber is found but it is nowhere of much size, and that there is just about enough of it available for initial mining operations and the building of cabins. Game is scarce, fish plentiful, and flies are a plague. Surely this is not a region that would appeal to the tenderfoot.

THE airplane has played an important part in the discovery of radium in the Great Bear Lake region of Canada. The conservative element of the mining profession has always scoffed at the idea that riches were to be found far up in this wild country—"the great beyond," as it is affectionately referred to in mining circles. Strange characteristics of geology and archeology have been brought to light when the aerial route has been substituted for the beaten path. The explanation is simple. From the vantage point of an airplane, watch a farmer, on a brisk autumn morning as the sun strikes the frost of the fields and turns it into sparkling dew-drops. The farmer's footprints as he crosses the fields are plainly visible, although from the ground they could scarcely be distinguished. Just so have the achievements of the departments of public works of the ancients as well as nature's geologic heavings escaped the searching eyes of the archeologist and the prospector until they took to the air. Then they are revealed as if by magic. [See "Archeology from the Air," by Stanley Casson, Scientific American, September, 1936, pages 130-132.—Ed.] The prospector has not been slow to adopt the airplane as an aid in detecting strata which reveal in striking clarity veins of material which can be charted and marked for further and closer scrutiny.

Thus it was that Gilbert La Bine, a Canadian mining engineer, and Leigh Brintell, chief of the Western Canada Airways, in the summer of 1929, flew over the Great Bear Lake region, hunting in this ship of the neotechnic age for outcrops and formations that were evolved by nature long, very long, before even the paleotechnic age began. Their first reward came in the discovery

Filtering purified radium bromide at the Eldorado refinery before starting the evaporation of the barium content. The uranium, silver, manganese, and other by-product materials are separated during the earlier stages of the recovery

of iron and quartz, revealed by a rusty stain 200 feet wide. Closer inspection revealed copper, silver, and cobalt deposits, some of the copper occurring in mass boulders 60 tons in weight. Having glimpsed this storehouse of nature's treasures, they returned to civilization, where La Bine immediately prepared for a return trip. Despite the fact that it was the month of February, he flew to Great Bear Lake and, after four months, discovered the radium-bearing pitchblende deposits and named the site La Bine Point.

GREAT BEAR LAKE is about as large as Lake Ontario and is but one of the frontier spots in the Canadian Northwest Territories which consist of over 3,000,000 square miles of wild country. The rugged fastness of the whole region is broken only by stations of the Hudson Bay Company, the Canadian Northwest Mounted Police, missions where the priest may be able to put in an appearance but once in the year, and by the cabins of trappers and foresters. Transportation, such as there is, consists mainly of horses and canoes in summer and dog-sleds and snowshoes in winter. The dogs are part wolf, and tales that make the blood run cold have been told of their ferocity when the awful grind of toil fails to keep their semi-savage brains dormant and docile. The airplane, a godsend in one sense, is a hazard in another. La Bine and his party found the wreckage of another prospector's plane on the shore of Hunter Bay. It was easy to reconstruct what had happened. That prospector was an experienced flyer but in the Far North nature does not provide landing fields and it is not an easy feat to judge one's distance. The plane had crashed and the pilot drowned—all due to a few feet.

So rich (90 milligrams per ton) were the radio-active ores which La Bine brought back to civilization from this second trip that it would even be profitable to transport the ore by airplane freight 1000 miles to the end of steel at Waterways, Alberta, and pay the $1.30 per pound charged for air freight. Radium history again runs in parallels, for it will be recalled that the Congo ore was transported to Belgium for refining, although in this case it was brought by steamer at a rather low freight rate. Eldorado Gold Mines Ltd. sank a shaft into the Great Bear Lake vein and built a mill for crushing and concentrating the ore at the site of the mine. The mine and the mill are electrically operated and 100 men produce 75 tons of ore daily. Three thousand miles away, at Port Hope on Lake Ontario, the refinery was erected and is in operation. No secrecy surrounds the activities, and information is readily and courteously given by the mine operators. The Canadian Bureau of Mines conquered the ore treating problem and Dr. Marcel Pochon, a noted French scientist, who began his radium career in the Curie laboratories, took charge of the processing and adapted to large scale production the methods originally worked out by Madame Curie. In Canada radium has achieved the status of an industry, and at the present time the refinery capacity is being tripled.

Silver is also produced from the vein in the Sub-Arctic and this goes directly into a smelter. The pitchblende is shipped in neat, small bags, and the bags themselves are burned at the refinery and treated as radium-bearing ashes. Strictly speaking, no pure radium—that is, metallic radium—is produced. In fact, there is practically none in existence. Radium bromide, the final product at Port Hope, is about 90 percent radium, looks like common salt and is sealed in glass tubes about the thickness of a match. From Port Hope the radium goes to the National Research Council at Ottawa, where its official strength label is affixed, and then usually to Great Britain where it is changed to a sulfate and sealed in needles, plaques, or bombs.

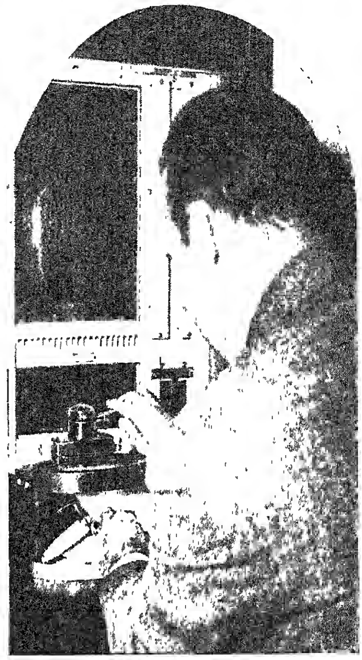
The medical world has watched with keen interest the development of the radium industry in Canada during the past few years. Because the Canadians could obtain no aid from foreign radium interests, they were forced to solve the intricate chemical problems themselves. They have succeeded admirably—so much so that Dr. G. E. Richards, internationally known radiologist, said recently that he considered this Canadian achievement in making radium more plentiful and cutting the cost in half "the greatest contribution to the treatment of cancer in the lifetime of anyone now living."

(*To be concluded*)

The scene of Gilbert La Bine's pitchblende discovery where, during the last six years, a modern mill and electrified mine plant have been built on the

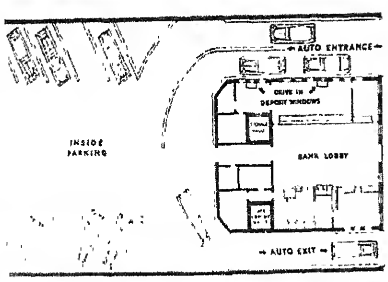
# Banking By Automobile

WHAT is reputed to be the first drive-in bank in the world has recently been opened at Vernon, a suburb of Los Angeles, California. When he wants to do business at this bank, the motorist need not search for a parking place for his car; he merely drives into the bank building and transacts his business without even moving from his seat. Convenience for patrons is coupled with safety by bullet-proof glass and an automatic gateway, shown below.



Mirzaoff Photos

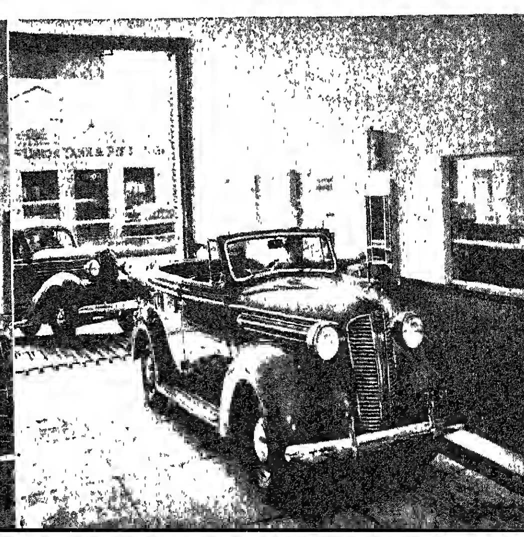
*Above:* The motorist places his pass-book in a rotary container which is actuated by the teller. *Right:* Floor plan of the auto-bank, showing driveways and parking space in the building




*Above:* Interior of the bank teller's cage, showing the means by which he operates the rotary container in which are deposited pass-books, checks, and so on. The window is bullet-proof and outsiders cannot gain access to the cage through the container

*Below:* The electrically operated gateway closed after a car has entered the bank. It is automatically operated by the approach of another automobile

*Below:* A motorist concluding a transaction at the teller's window, and another car entering



# Health Aspects of Air Conditioning

TODAY in scores of research laboratories over the land the complexion of the air-conditioning industry is undergoing fundamental changes that will alter the public conception of this art and launch it into new fields of public service or direct it up avenues that were unthought of a few short years ago.

Working with known facts developed over the past decade, engineers and scientists see the industry on the threshold of developments likely to have a profound effect on sociological, public health, and medical problems. In short, air conditioning is beginning to broaden its own base and become a powerful factor for the general good instead of an expensive luxury for the comparatively few.

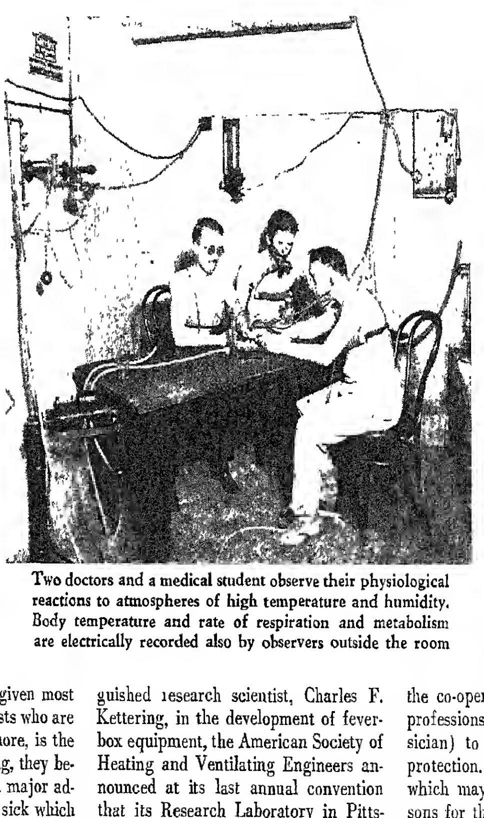
Let us, for the moment, dismiss the familiar examples of present-day air conditioning as experienced in the department store, your favorite restaurant or movie theater, and the scores of other places where air conditioning has become almost commonplace. The future in such fields is already well mapped out.

The more fascinating aspect of air conditioning lies, not so much in a speculation of its more accepted applications, which will take place more or less as a matter of course, but in examining the underlying trends that are taking definite shape in the research laboratory out of which entirely new applications may be born. The field that is being given most consideration today by scientists who are looking ahead a decade or more, is the medical field. Air conditioning, they believe, is on the threshold of a major advance in the treatment of the sick which is destined to develop into an important tool of the medical profession.

BOUND up in this subject, a new phase of air conditioning is appearing—air sanitation. In the not-so-distant future, air conditioning will contribute importantly to hygiene, and promises to assume a significance second only to that of food and water. Thus, intensive work is going on to find out what beneficial effects air conditioning will have on health and how it can be used in the treatment of disease.

That it has already found a place in certain phases of fever therapy was attested to at a recent gathering of distinguished physicians who met in New York to discuss the advantages of the so called "fever box," in which air conditioning has been found to be the most reliable and safest method for artificially raising body temperatures with complete protection against burns.

Following the work of the distinguished research scientist, Charles F. Kettering, in the development of fever-box equipment, the American Society of Heating and Ventilating Engineers announced at its last annual convention that its Research Laboratory in Pittsburgh had worked out the design of an air-conditioned fever box and gave a résumé of the results accomplished with it during the course of a long investigation, undertaken in co-operation with physicians of St. Francis Hospital in Pittsburgh.



**Two doctors and a medical student observe their physiological reactions to atmospheres of high temperature and humidity. Body temperature and rate of respiration and metabolism are electrically recorded also by observers outside the room**

Drawing upon the data collected over a period of years—relating to the physiological effects of high temperatures and humidities on the human body—equipment was developed with which it is now possible to subject patients to temperatures from 105 to 110 degrees, Fahrenheit, in a saturated atmosphere.

It has recently been re-discovered that certain diseases, notably syphilis and gonorrhea, react favorably to elevated body temperature. Extraordinarily interesting results followed the development and use of the air-conditioned fever box in the Pittsburgh tests, indicating that air conditioning will play an increasingly important part in fever therapy toward the treatment and cure of the so-called social diseases.

Speaking as head of a group of researchers engaged in studying other organic effects of air conditioning on humans, Walter L. Fleisher, consulting engineer of New York, says that recent studies of air conditioning for the benefit of the abnormal are leading to better understanding of adapting air conditioning to the needs of the normal person. This is leading to the exploration of new avenues of research relating to the greater field of general human comfort.

"THE immense possibilities on the medical side of the picture today are hardly realized, even by their most ardent supporters," says Mr. Fleisher. "Consider what can be accomplished—indeed, what is being accomplished—by the co-operative approach of two great professions (the engineer and the physician) to national problems of health protection. Research is now going on which may uncover the causes or reasons for the curative quality of the air in tubercular centers, such as Arizona, and enable us to duplicate this air in air-conditioned sanitariums in the East. The effect of high temperature and high humidity air on the insane, instead of the commonly used high-temperature water baths, is another field which holds much promise. Hospitals today are taking a greater interest in air conditioning than at any time in the past. Much constructive progress is now being made in practical researches for determining the technical and medical benefits of air conditioning in the operating room,

laboratory, clinic, and recovery wards."

Air conditioning, combined with ultra-violet treatment of entering air, has been responsible for marked improvement in the post-operative infection rate —lessening post-operative shock, greatly shortening the period of convalescence, decreasing the rise in temperature and showing a marked sedative effect, according to Dr. Robert F. James of the Westinghouse Lamp Company, who is bringing the physician's viewpoint to air-conditioning research.

# Much Research Broadening Base of Air Conditioning . . . Sociological, Medical Problems Studied . . . Greater Health, Comfort, Satisfaction the Aim

By BREWSTER S. BEACH

THE possibilities which seem to lie ahead of air conditioning in the field of air sanitation and air sterilization have been responsible for the determination of the industry to find out what there is about natural outdoor air that, on a brisk winter morning or a balmy spring afternoon, gives it a tang and zest that makes us exclaim: "Isn't the air great today!" To find, if possible, and to imprison this sparkling quality of outdoor air within enclosed spaces, is the present task of a distinguished committee of engineers, physicists, physicians, public health authorities, and chemists headed by Professor C. E. A. Winslow, Director of the Pierce Laboratory of Hygiene of Yale University. It is called the "Committee on the Treatment of Air with Electricity," and is actively functioning as a technical advisory committee to the Committee on Research of the American Society of Heating and Ventilating Engineers. Should success crown its efforts—and there seems to be good reason to believe that a solution can be found—there may follow profound changes in air-conditioning practice.

Air conditioning will have taken a very big forward step when it is able to duplicate nature's air at its very best. The problem is concerned with three major questions: (1) Ionization of air; (2) Ozonation; (3) Ultra-violet sterilization of air. The first action of the committee has been to try to find the real cause of so-called "bad" or "stuffy" or "stale" air.

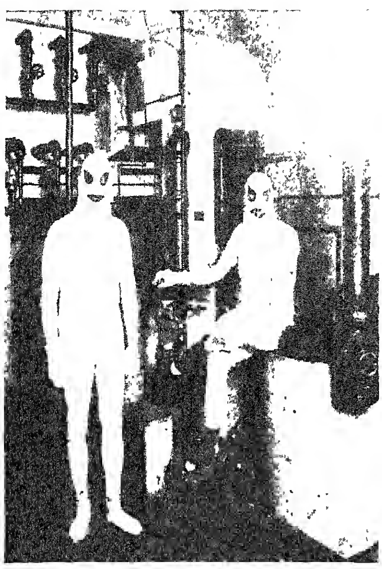
According to Dr. G. R. Wait, physicist of the Department of Terrestrial Magnetism of the Carnegie Institution, Washington, a member of the committee studying this question, such a condition may be caused by the exhalation of minute particles in the human breath, known as ions, which run as high as 200,000,000 particles per breath, and which sometimes remain suspended in the air for considerable lengths of time.

Observing skin temperatures with thermocouples in a study of physiological reactions to various indoor atmospheric conditions

Measuring air leakage through a wall resulting from wind pressure on the outside. An eight-inch brick wall, with furring lath and plaster, forms a partition between two compartments in the sheet metal enclosure shown. A wind velocity pressure against the outside of the wall results in air leakage through it. This is measured as it passes through an orifice in the wall of the metallic enclosure

"These particles," says Dr. Wait, "tend to accumulate in the air of a closed room occupied by people and, consequently, will, to some extent, be taken into the lungs of other individuals in the room. Since experiments have definitely shown the fallacy of earlier assumptions that the accumulation of carbon dioxide in the air of occupied rooms was responsible for the gradual development of 'bad air' in the room, no logical cause for the 'bad air' is now known. However, it is altogether logical to believe that a possible cause for the development of 'bad air' is the accumulation of the small breath particles in the air of an occupied room.

"ASSUMING this to be the real cause for the development of 'bad air,' the solution is to be sought in the elimination or removal of these small breath particles from the air of the room. Since further investigations have shown that the majority of the breath particles are charged about equally positive and negative it should be possible to remove them by means of an electric filter. On the above assumption as to the cause



The head-dress served as a frivolous touch to an otherwise serious day's work of two eminent leaders in the development of air conditioning: Willis H. Carrier and E. Vernon Hill. One served as a "wet-bulb" and the other as a "dry-bulb" in determining a person's "feeling" of warmth. As a result of these studies, the Effective Temperature Index of warmth now receives almost universal acceptance as the basis for air conditioning design

for the development of 'bad air,' such filtering process should immediately revitalize the air.

"The amount of energy involved in the particles is small, but can conceivably have some influence on the action of the membrane surfaces of respiratory passages and lungs, if it were increased or decreased by changes in the concentration of these particles in the occupied spaces.

"The particles are not dust particles. They act as condensation nuclei and are hygroscopic in nature. It is not possible at present to say exactly what they are physically. It is possible that the 'disease' (bad air, staleness, and so on) in occupied spaces is related to the accumulation of these nuclei. If this were true, the proper course would not be a remedy in terms of the addition of ions to a ventilating system, but rather their removal. Ordinary filters would probably not be effective, but filtering could be accomplished by electro-static means.

"It also seems important to investigate more completely the possibility of an electric charge being delivered up to the air or, in other words, that the lungs retain an electric charge, and consequently require an electric current, even though minute, to flow to the point from which the charge has been ejected from the lungs. Undoubtedly, many of these charged breath particles are bacteria, some of which may be harmless to those breathing them, yet many may be malignant. A determination of the percentage falling into each class should prove to be an important study."

Another phase of this investigation into the intangible qualities of air, revolves about the subject of filtration of air by electrical means. Dr. L. W. Chubb, of the Westinghouse Electric & Manufacturing Company, another member of the committee and a contributing editor of Scientific American, reports on the interesting results of tests made in a Pittsburgh telephone exchange to free the air of minute dust particles which frequently interfered with the proper operation of sensitive electric relays. A highly efficient method of mechanical filtration was first tried, consisting of passing the air entering the room through moist blankets. When this did not accomplish the results hoped for, electric filtration on the precipitation principle was installed. Not only was the dust that had been harmful to the electric apparatus removed, but the experimenters found, much to their surprise, that the air thus filtered was given an added quality that might be termed "re-vitalization." In addition, the telephone operators working in such air responded in a favorable manner and remained free from colds and influenza. In fact, the operators were quick to detect whether the mechanical or the electrical system of air filtration was in use by the "feel" of the air in the room.

The comfort which you now experience when you enter a store or theater on a sizzling summer day, harks back beyond the development of the mechanical equipment that makes this possible. It began almost 20 years ago in the fundamental study of the physiological reaction of people to their atmospheric surroundings. Out of this basic research came the determination of the comfort zone on the psychometric chart which enables the air-conditioning engineer to foretell with extreme accuracy within what given range of temperature, humidity, and air motion the majority of persons will feel most comfortable.

IF you are one of those persons who think you catch cold from the shock of entering an air-conditioned theater, it will interest you to know that research is trying to do something about it. All this summer tests have been going on in different parts of the country to determine exact and scientific requirements for summer cooling. This may have the salutary effect of curbing the zeal for advertising "20 degrees cooler inside," and result in fewer cricks in the neck and more satisfaction to the air-conditioned customers whose loud squawks are not infrequently to be heard in the market places. As the result of the initial co-operative research on this subject undertaken by the Texas College of Agriculture and Mechanical Engineering, and the Ontario Research Foundation, effective temperatures ranging from 71 to 73 degrees have been found to approximate most nearly the maximum comfort zone for the majority of people.

Parenthetically, it should be stated that "effective temperature" is not what you read on your thermometer. It is rather a composite indication of dry-bulb temperature, wet-bulb temperature, relative humidity, and air velocity

Studying effect of wind on heat losses from buildings. A wall section was set up on moving truck and Pitot tubes measured wind velocities while existing

But what about drafts? Some persons, facetiously or half in earnest, are wont to complain that air conditioning to them "is nothing but a draft in the back of the neck." The subject of drafts is being taken rather seriously by the researchers. What to do about them, how to eliminate them? The first problem is to find out what a draft actually is, then track it to its lair, and figuratively put salt on its tail. Just that sort of research is now starting with the expectation that by studying the physiological reaction of people to the common draft, enough will be learned about them to prevent undue exposure to drafts by improving upon or developing better scientific methods for distributing air.

OUT in the Pittsburgh laboratories of the American Society of Heating and Ventilating Engineers, scientists under F. C. Houghtin, director of research, are discharging drafts of air of known temperatures, humidities, and velocities at various parts of the bodies of a number of human guinea pigs to determine what really constitutes a draft. Is it, for example, a question of temperature, humidity, and air velocity, or merely a matter of where a draft strikes you—or both? The answer is in the making. When the solution is found, one may expect to receive even greater comfort and satisfaction from air-conditioning systems than is now the case. Thus the inquiring minds of the scientists range over the air-conditioning scene, seeking to attack problems at their source, taking a long-range look.

One of these long-range looks is related to the interesting subject of water on roofs. Sounds curious, doesn't it? But predictions are freely heard that one of the features of the air-conditioned home of the future will be a flat roof containing two or three inches of water, stored there the year round to help keep the house cool in summer and warm in winter.

The insulating value of water is very considerable. In the liquid state in summer it exerts an even evaporative cooling effect; in winter, if it freezes, the ice adds an extra layer of insulation. And water is also considered an excellent protection for the roofing material.

Lieutenant Colonel W. A. Danielson, chairman of the A. S. H. & V. E. Committee on Research, calls it "a development of major economic importance," and cites instances where water insulation has been able to save as much as 25 percent in cooling costs. To find the insulating value of water-covered roofs is the primary purpose of the investigation just getting under way.

So many and so varied are the problems with which the heating, ventilating, and air-conditioning industries are

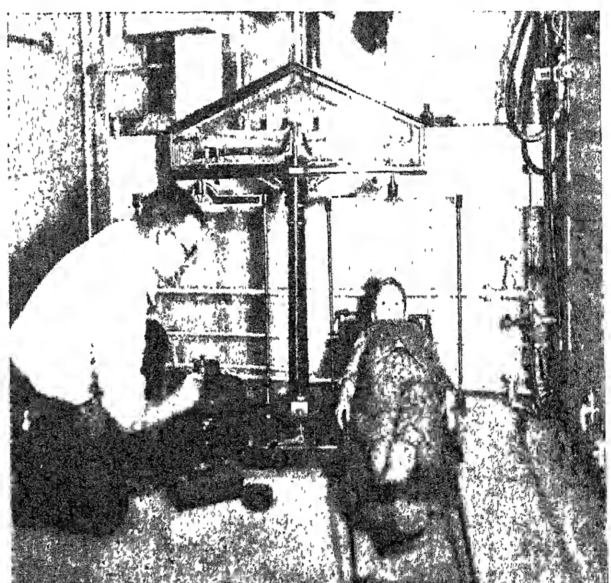
To keep buildings cool in summer and warm in winter, water insulation on roofs is the latest in air conditioning. Its usefulness is being carefully studied

upon only a few of them. The industry's research program for 1937-1938 includes new or continuing studies of:

Air-Cleaning Devices, Air Conditioning in Relation to Comfort, Air Conditioning in the Treatment of Disease, Air-Conditioning Requirements of Glass, Atmospheric Impurities and Resulting Safety and Health Requirements, Climate and its Relation to Air-Conditioning Fundamentals, Comfort Requirements for Summer Cooling, Corrosion in Heating and Air-Conditioning Systems.

Direct and Indirect Radiation with Gravity Air Circulation, Effect of Entering Temperature and Velocity on Temperature and Distribution of Air Within an Enclosure, Frictional Resistance to Flow of Air in Ducts, Insulation, Psychometry, Refrigeration in Relation to Air Treatment, Sound in Relation to Heating and Ventilation.

A further idea of the work that is going on may be gained from the statement that some 30 or more universities, at least four government bureaus, seven technical societies, an equal number of trade associations, and no less than 22 private industrial laboratories are engaged in investigating 247 subjects directly and indirectly related to heating, ventilating, and air conditioning. The services of upwards of 2000 persons are involved. Yearly expenditures compared with other kinds of research are small, probably running in the neighborhood of 1,000,000 dollars per year.



Balance for studying heat exchange between body of a person and his atmospheric environment. He loses weight—a gram or more a minute—from perspiration evaporation, moisture exhalation, oxidation of carbon in food eaten

# STATUS OF THE CARRIER

## Aircraft Carriers a Permanent Element of Fleets . . . Most Navies Have Them . . . Evolution of Their Design . . . World Carriers Built and Building

By WALTON L. ROBINSON

OF the seven leading naval powers of the world, all but Italy and Russia have adopted the aircraft carrier as an indispensable type of naval vessel. The admirals of the United States, British, Japanese, French, and German navies are fully cognizant of the great value of aircraft, and of the necessity of providing floating bases for the planes so that these may operate to the best advantage with the fleet. Between them, these five nations possess 17 completed carriers and 13 under construction, appropriated for, or definitely projected. Although the Italian and Russian navies have no carriers, they are not neglecting their air strength; their lack of interest in the carrier is simply due to the fact that their naval strategic problems do not demand this new type of warship, for the relatively narrow waters of the Mediterranean and Baltic permit effective employment of naval aviation from shore bases.

Like its older companions—the battleship and cruiser—the aircraft carrier has been limited both in regard to tonnage and gun caliber by the several naval treaties signed since the end of the World War. The first—that signed in Washington in 1922—set the limits at 27,000 tons and 8-inch guns (not more than 10 in number), while the most recent, the London treaty of 1936, reduced these limits to 23,000 tons and 6.1-inch guns. These last figures are those at present in effect. There is no longer any limit to the number of carriers a nation may possess. Under the Washington and 1930 London treaties, both of which expired December 31, 1936, total tonnage limits were fixed for each of the five contracting powers as follows: (1) United States and Great Britain, each 135,000 tons; Japan, 81,000; and France and Italy, each 60,000 tons. The only navy at present in any way restricted to the number of carriers it may possess is the German; by the Anglo-German agreement of June 18, 1935, the Reich's navy is limited in this class of warship, as it is in all the other classes save submarines, to 35 percent of the British tonnage.

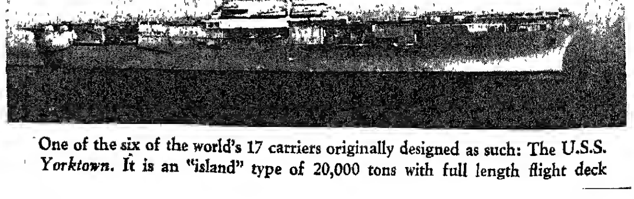
OF the 17 completed carriers of the world's navies, only six were originally designed as such. They are: U. S. S. *Ranger, Yorktown,* and *Enterprise;* British *Hermes;* and Japanese *Hosyo* and *Ryuzyo.* The remaining 13 are ships which have been re-designed as, and converted into, aircraft carriers. The British *Eagle,* Japanese *Kaga,* and French *Béarn* were begun as battleships; the U. S. S. *Lexington* and *Saratoga* and Japanese *Akagi* as battle cruisers; the British *Courageous, Glorious,* and *Furious,* as a hybrid type of cruiser which might be classed either as a lightly protected battle cruiser or a huge, heavily armed, scantily-armored cruiser; and the British *Argus* as a transatlantic liner; while the U. S. S. *Langley* was originally the old collier *Jupiter* which Congress, in 1921, gave authorization to be converted into an experimental aircraft carrier. Many of these conversions were carried out for economic reasons and it is likely that had new ships then been originally designed as aircraft carriers, they would have had very different characteristics from those of the transformed ships. This refers principally to the displacement and armament and not to the methods of handling and storing the planes.

**WORLD'S AIRCRAFT CARRIERS**

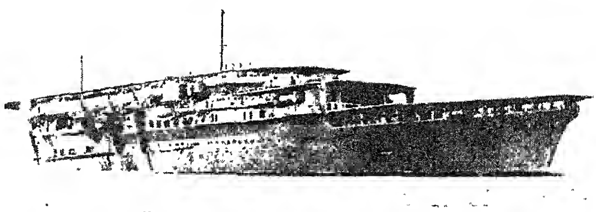
| | Completed | Displacement in Tons |
|---|---|---|
| **UNITED STATES** | | |
| *Langley* | 1921 | 11,500 |
| *Saratoga* | 1927 | 33,000 |
| *Lexington* | 1927 | 33,000 |
| *Ranger* | 1934 | 14,500 |
| *Yorktown* | 1937 | 19,900 |
| *Enterprise* | 1937 | 19,900 |
| **GREAT BRITAIN** | | |
| *Furious* | 1917 | 22,450 |
| *Argus* | 1918 | 14,450 |
| *Eagle* | 1920 | 22,600 |
| *Hermes* | 1923 | 10,850 |
| *Courageous* | 1928 | 22,500 |
| *Glorious* | 1930 | 22,500 |
| **JAPAN** | | |
| *Hosyo* | 1922 | 7,470 |
| *Akagi* | 1927 | 26,900 |
| *Kaga* | 1928 | 26,900 |
| *Ryuzyo* | 1933 | 7,100 |
| **FRANCE** | | |
| *Béarn* | 1927 | 22,146 |

IN 13 of the carriers—all six of the American, three of the British, three of the Japanese, and the solitary French one—there is a flight or landing deck which extends the entire length of the ship, or nearly so, while in the other four the flight deck terminates at an appreciable distance from the bow. This latter arrangement permits a short flying-off deck below. Whether there are one or two decks depends upon the methods used in handling the planes. Ten of the carriers have what is known as "island" superstructure; that is, the funnels, masts, navigating bridge, and so on, are located on the starboard, or right, side of the flight deck; the other seven have their landing decks entirely clear of such obstructions. The U. S. S. *Ranger,* originally designed to have this latter arrangement, was converted during construction to the "island" type. In those carriers with clear decks the smoke is disposed of in such manner as not to cause difficulties to the pilots as they alight on the deck.

The *Langley,* our first aircraft carrier, has two small funnels on the port side. During landing operations, they are lowered into a horizontal position in order



**One of the six of the world's 17 carriers originally designed as such: The U.S.S. *Yorktown.* It is an "island" type of 20,000 tons with full length flight deck**

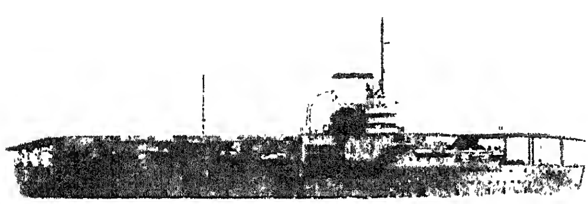


Courtesy *Jane's Fighting Ships*

**Japan's largest aircraft carrier, *Kaga*, has a novel deck arrangement. Upper one is for landing; two lower ones for taking off. Note funnel 400 feet long**

to leave an entirely unobstructed flight deck. The three somewhat larger funnels (on the starboard side) of Japan's oldest carrier, the *Hosyo*, operate in the same manner. This ship has a light mast which also is lowered outboard when planes are about to land. The British carriers *Argus* and *Furious* have internal horizontal smoke-ducts which expel all furnace gases and smoke abaft the after hangar. The Japanese *Kaga* had a somewhat similar arrangement, but her funnels or smoke-ducts, one on each side, were external and therefore plainly visible. The two funnels of this ship were enormous, measuring approximately 400 feet in length! The *Kaga* recently was reconstructed and now has a practically clear landing deck, obstructed only by a very small navigating house on the starboard side. She now discharges her furnace gases through a short, flat-sided funnel, turned outboard and downward, on the same side. The *Akagi* has a similar funnel, but immediately behind it there is a second one, short, round and in a normal, vertical position.

The present tendency in the design of



Courtesy *Jane's Fighting Ships*

**France's solitary aircraft carrier, the *Béarn*. Displacement is 22,146 tons. She is the only carrier mounting torpedo tubes, having four 21.7 inch tubes**

aircraft carriers, at least of those in our navy, is toward the "island" type, for experience has shown that, if the obstruction is not too large, there is little or no interference caused by air currents around the after part of the flight deck. In a small carrier, however, such as the new Japanese *Ryuzyo*, where the length is not great and the width of the landing deck is considerably less than in large ships, the relatively larger "island" superstructure can cause serious interference. Weight and space are usually saved by means of the "island"; it permits larger hangars and, therefore, better stowage for the planes. On the other hand, there is the inconvenience, even in the larger ships, that the "island" produces an unequal distribution of weight which often increases greatly the difficulties of navigation and keeps busy those whose duty it is to maintain the ship on an even keel.

THE displacements of the world's aircraft carriers range from the 7100 tons of the *Ryuzyo* to the 33,000 tons of our giant *Lexington* and *Saratoga*. The decisions regarding the tonnage of the newer carriers, especially those now under construction, have been in large part governed by the clauses of the Washington Naval Treaty of 1922. Our navy, to which were assigned 135,000 tons, had at its disposal after the completion of the *Lexington* and *Saratoga* some 69,000 tons. Our original intention was to build five carriers, each of 13,800 tons. Eventually, however, it was decided to construct but one ship of this size, the *Ranger*. In the next two vessels laid down, the *Yorktown* and *Enterprise*, the displacement was increased to 20,000 tons. Apparently our naval authorities feel that two ships of this size are of greater value than three of 13,000, the total tonnage in either case being about the same. The beloved late Rear Admiral Moffett at one time declared, however, that he believed the ideal size for an aircraft carrier to be that of the then projected *Ranger*.

America's lone carrier at present under construction, the *Wasp*, is to displace 14,700 tons. Although she will thus be only slightly larger than the *Ranger*, it is expected that she will more closely approximate in appearance the new *Yorktown* and *Enterprise*, being a small edition of these two splendid ships. The tonnage selected for the *Wasp* was the greatest possible without exceeding the treaty limit of 135,000 tons.

Omitting the oldest and more or less obsolete carriers, the speed of this type of warship varies from 23 to 34 knots. It is interesting to observe that, in every case, the transformed carriers retain the horsepower and speed provided in the original design as battleships, battle cruisers, and so on. Of those originally designed and completed as carriers, the *Hermes*, *Hosyo*, and *Ryuzyo* steam 25 knots, the *Ranger* 29.95, while the *Yorktown* and *Enterprise* are capable of about 34 knots, the highest speed of all.

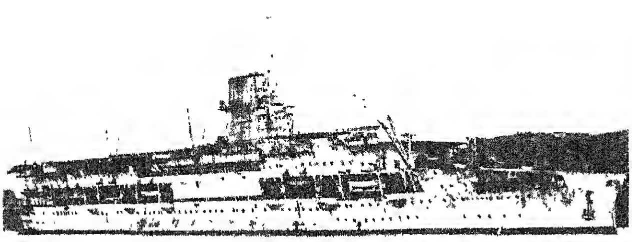
The desirable speed for this type of ship is governed by tactical considerations. When planes are landing or taking off, the carrier's bow must be turned into the wind; to do this it naturally is necessary for her often to steam a course different from that of the fleet which she accompanies. Thus, in order not to fall behind and lose contact, the carrier should have a somewhat higher speed than that of the other large ships. In addition, her propelling machinery should be exceptionally robust and flexible so that frequent alterations in speed will not cause an engine-room breakdown at a critical moment.

THE number of planes which the various carriers are able to accommodate varies greatly and makes for some interesting comparisons. The *Furious*, with an unobstructed flight deck and horizontal smoke-ducts, carries 33 planes; her modified sisters of the "island" type, the *Courageous* and *Glorious*, transport 48 apiece. The Japanese *Akagi* and *Kaga* are each of 26,000 tons and have identical armament, but the former has about 50 percent more powerful engines and consequently a higher rate of speed, hers being 28.5 knots to the *Kaga's* 23 knots. This higher speed costs the *Akagi* some 20 planes in maximum carrying capacity, her complement being 60 planes, while that of the slower *Kaga* is 80. The influence of speed upon the plane stowage of a carrier was brought out clearly in 1929 when the Naval Affairs Committee of Congress was informed that an increase of three knots in the proposed speed for the projected *Ranger* would reduce by 40 percent the number of planes she could carry and operate.

Although it is easy for comparisons to be made between the number of planes borne by the various carriers of one navy, such is not the case when comparing the carriers of one navy with those of another, for governing factors other than speed must be taken into consideration if one is to understand the disproportionate number of planes carried by certain ships. In proportion to their size, our carriers are able to accommodate a larger number of planes than their foreign contemporaries. Taking as an example our new carriers *Yorktown* and

*Enterprise*, of approximately the same displacement, armament, and speed as Britain's recently launched *Ark Royal*, we find that our ships can carry 100 planes each, while the Britisher will accommodate no more than 70. In the older carriers of the two navies, this difference is even more marked. In searching for an adequate explanation of this disproportionate plane capacity, only two reasons can be found: (1) the fact that all of our carriers have a larger percentage of small planes (fighting, scouting, and so on, as opposed to huge bombers) than is the rule in their British contemporaries: and (2) the practice in American ships of stowing a greater portion of the planes in a partially disassembled state.

The question of armament calls for but few comments. The powerful 8-inch gun batteries of the *Lexington*, *Saratoga*, *Akagi* and *Kaga* are abnormal and not likely ever to be repeated. The most recently completed carriers and those under construction mount only anti-aircraft guns, 4.7-inch in the British Navy and 5-inch in ours and the Japanese. These guns are "dual purpose"; that is, they can be employed against ships as well as aircraft.



Courtesy U. S. Naval Institute

**A British carrier: H.M.S. *Glorious*. Note funnel on starboard beam, crane to lift seaplanes, and the water-line bulge for defense against torpedo attack**

As can easily be imagined, in the type of naval vessel under discussion there are a great many installations of various kinds which are not to be found on other warships. Most important of these are the hangars. These are huge open spaces which have no counterpart whatsoever in any other type of craft. They are generally from 15 to 18 feet high by some 50 to 60 feet wide and 350 to 450 feet in length. As they usually are filled with gasoline vapors they are spaces of considerable danger. Inasmuch as transverse bulkheads are out of the question, the subdivision of the hangars is obtained by means of steel screens moved by electric motors, and by thick asbestos curtains. There is, of course, a very complete fire-fighting apparatus installed inside the hangars. There is also ample provision for combating deck fires—as when planes have crashed and caught fire, for example. Powerful electric ventilators expel the dangerous gases from the interior of the hangars.

Another peculiarity of the aircraft carrier is the huge elevators which are employed for taking planes from the hangar to the flight deck or vice versa. Usually there are two such lifts, one at each end of the hangar, though the French *Béarn* is known to have three. These lifts generally measure about 50 feet square. They are worked by hydraulic power and operate very swiftly.

As the huge hangars must be free from hindrances of every kind, the necessary piping for the expulsion of smoke, ventilation of the engine and boiler rooms, and so on, has to be located on the sides of the ship, usually below the level of the hangar deck. The sides of the ship are therefore very crowded with all sorts of equipment. The rapid supply of shells to the guns is another difficulty encountered in this class of naval vessel.

Yet another problem peculiar to the aircraft carrier is that of the storage of fuel for a large number of planes. This fuel is stored in huge cylindrical tanks at each end of the ship. An extensive network of piping distributes the gasoline to various sections of the hangar, and to the flight deck. Compressed air is generally used to force the fuel through the pipes.

The task of checking the movement and bringing to a final stop the returning planes as they land on the flight deck is another interesting and troublesome problem. The mechanism employed has to be capable of stopping various types of planes—from those weighing 3500 pounds to those of 9000—and at landing speeds which may vary considerably. In all probability, the United States Navy leads all others in the development of the best method of bringing planes to an early stop after they have alighted on the flight deck. Needless to say, enormous advances have been made in this respect since 1911 when Ely landed on the crude and improvised installation set up experimentally on the old armored cruiser *Pennsylvania*.

The aircraft carrier proper is not the only type of naval vessel designed especially for the transport and operation of aircraft. There is also the aircraft tender, a vessel which can carry out all the functions of the carrier except to take its returning planes back on board right from the air. In other words, the aircraft tender differs from the carrier in that it has no flight deck. Her planes must land on the water nearby and then be hoisted on board by means of a crane. Of this type of ship our navy has but one of any importance: the *Wright*. France several years ago completed the *Commandant Teste*, which is capable of carrying some 30 seaplanes; Italy possesses the *Giuseppe Miraglia* (transformed from a liner) with accommodation for 15 seaplanes, while Japan, too, has a number of improvised aircraft tenders in service, with three of 10,000 tons building.

Sweden recently completed an interesting and novel type of warship: the flying deck cruiser *Götland*. On a displacement of only 4600 tons, she carries six planes and a catapult. For her size she has the good armament of six 6-inch guns, four 3-inch anti-aircraft guns, and six 21-inch torpedo tubes. The speed of 27 knots is on the low side, however.

THE world's leading naval powers are at present building or will soon start work on no less than 13 aircraft carriers. We are building one: the *Wasp*. Britain is building three: the *Ark Royal*, *Illustrious*, and *Victorious*, and she will soon lay down two more. Japan has the *Soryu* and *Hiryu* well advanced and a third projected. France plans to begin work on two in the near future, while Germany is rushing a pair to completion.

The aircraft carrier promises to grow in importance with each succeeding year, and there is no doubt that it will take a prominent part in the next war in which large naval powers are involved. This will be especially true in a war in which the distances between the belligerent nations are great—too great to permit the effective employment of shore-based aircraft. The carrier is the sole solution to such a problem.

*Publication of the foregoing article completes a series of four excellent studies of as many elements of sea power by the same author, Mr. Walton L. Robinson. These have appeared at intervals during 1937 and, if we are to judge by readers' comments and numerous press clippings, have excited considerable interest.*

*Because of the world's present huge naval building programs, we expect to present other similar articles regularly during the coming months. If you have any suggestions to make or would like to comment in any way, it would be our pleasure to hear from you.*—The Editor.

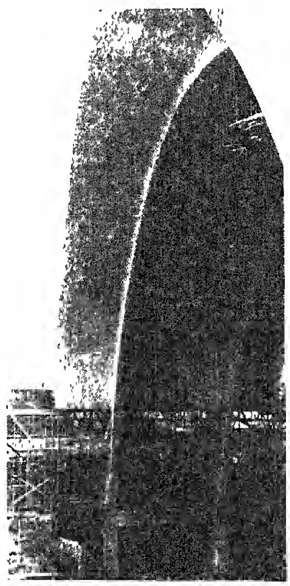
The Hershey Sports Arena is topped by the widest span, monolithic concrete roof in this country

# MONOLITHIC SHELL ROOF

CONCRETE shell roofs, so called because of their similarity to shells found in nature, are a comparatively new development. Such a shell dome is comparable to half a gigantic egg shell, the strength of which is well known.

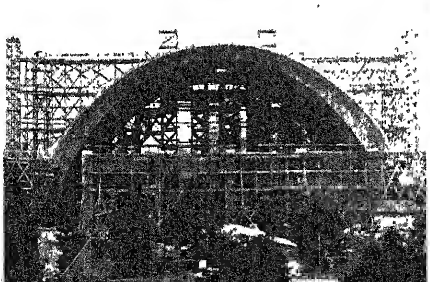
The principle of crowning or curving plates to produce rigidity has long been recognized and utilized in the industrial world; corrugated iron, automobile fenders, dish pans, paper dishes and spoons, and other articles in daily use are made into rigid units from thin sheets of metal or cardboard curved in one or two directions. All these thin curved plates have excellent structural properties.

Only last year the principle of having a thin, properly reinforced concrete plate curved and stiffened in a similar way was used in roofing the Sports Arena in Hershey, Pennsylvania. Here a concrete shell 3½ inches thick, stiffened by arch ribs on 40-foot centers, carries over a distance of 222 feet without intermediate columns, beams, purlins, or other intermediate supports. The shell is the outstanding feature of the structure. No ugly steel framing, bracing, or diagonals are used. The inside of the hall is clear of obstructions; a monumental appearance, fireproofness, and permanence were attained. Heretofore, a structure like this arena would have been of steel construction since a structural solution in concrete was beyond the conception of any architect or engineer.



Detail of a section of the roof of the Arena, showing carrying arches

The plan area covered by the roof is 232 by 340 feet; the over-all dimensions of the building are 245 by 356 feet. There are eight carrying arches, each with a span of 222 feet. The roof was designed by Roberts and Schaefer Company, Engineers, Chicago, and constructed by Hershey Lumber Products, the building organization of the owners—the Hershey chocolate interests. Though the design of this structure is quite intricate, the construction offers no unusual problems and could be done by local labor in a small town.



When the roof was under construction, an enormous

The completed 3½-inch shell roof over a first-night audi-

# THE FALLACY OF FIGHTING

## We Call Our Age the "Age of Science," but the Insects Know it is the Age of Insects . . . The Hope of Exterminating These Sportsmen's Pests is Futile

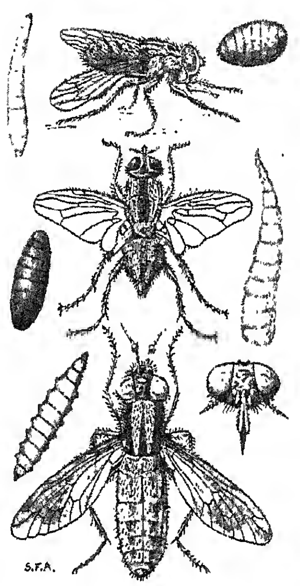
By S. F. AARON
Drawings by the author

THE quite natural wish which most of us entertain to diminish the existing numbers of flies is a pleasing thing to contemplate, but it sometimes leads us in the direction of expectations that can never be realized in actual fact. In the present discussion, only those species of flies that are nuisances, and that have been proved detriments to health, will concern us most. These are the house flies, the biting stable and horn-flies, the several kinds of blood-sucking horse, deer, and green-headed gad-flies, the bot and warble flies of horses, cattle, and sheep, the mosquitoes, and the black gnats or midges that the expressive Indians have called "no-see-ums." These species are all of the order Diptera—insects with but two wings. Not all their kindred are to be classed as pests, for many have no influence whatever upon the affairs of mankind, while others are positively salubrious; for example, the pollenizing bee-flies, the parasitizing syrphus and tachinid flies and the robber-flies that destroy many noxious insects, though some that are beneficial as well.

It is certain that it is quite beyond our power to limit appreciably the number of some species of noxious insects. Among these are the most pestiferous kinds, alike threatening man and domestic animals. These flies are carriers of fatal diseases, endemic and sporadic.

ALL the pestiferous species of flies find means of perpetuating their too numerous individuals in ways beyond our reach. Wherever farm stock exists, for example, there will always be flies, the larvae finding abundant sustenance in and about barns, stables, sties, poultry houses, outhouses, garbage, all over pasture fields, in the excrement of dogs, cats, and wild animals, in woodchuck and ground squirrel burrows, wherever flocking birds roost, and in almost all kinds of rotting vegetation. Moreover, it is altogether an error to suppose that the drying out of certain matter will prevent its further use as food for larvae, for the maggots carry or bring sufficient moisture to render anything palatable. A common error is to assert that the common house-fly does not frequently breed in cow manure.

Small wonder is it, then, that *Musca domestica* and its many relatives are exceedingly plentiful, at least at nearly all times when the temperature is above 56 degrees. Fahrenheit. Not remarkable is it also that the several species of biting flies, the tabanis group, appear seasonally in threatening numbers to interfere with the dairy output and sometimes to cause serious illness because of their septic inoculation—septic because the larvae occur anywhere in moist earth and the shallow waters of swamps and marshes.




*At top:* **Stable fly, larva, and pupa.**
*Center:* **Horn fly, larva, and pupa.**
*Bottom:* **Green-head biting gad fly, larva and its sucking proboscis**

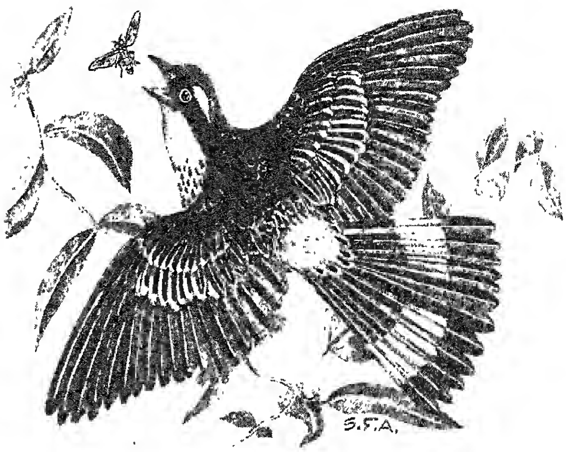
If these conditions could be done away with over a vast extent of country, it might lead to the supposition that the pests could be extirpated. However, the supposition would be absurd, and even if it were not, the effort would be far too great.

The puncturing stable-fly, a near cousin to the house-fly, breeds in situations similar to that of the domestic pest but is far less common, for reasons not difficult to understand; one or more kinds of active parasites affect it. The horn-fly occurs in vast numbers and breeds in manure of all kinds; it is an economic curse because it adversely influences cattle.

It has long been asserted that the complete destruction of flies would be a not too difficult matter. On the contrary, it would be so exceedingly difficult, expensive, and its desirable results so well-nigh impossible that, as an undertaking with the expectation of practical value, it may well be discarded. These creatures—the flies—are of the strong-winged class of insects; they travel far and fast, and they need only a few weeks of warmer weather to reproduce their kind. They would have to be combatted throughout very wide areas, involving the coordination of large communities of people who must not stop at expense and trouble. And then, after much effort has been made, and the optimists are preparing to congratulate each other upon the (imaginary) results, the flies, in a majority of cases —in all cases, in fact—will eventually prove to exist in about the same numbers as they did before. Where they come from would be as much of a question as why flies are, anyway. The idea of screening all manure and other breeding places, and of treating all with poison or deterrents of any kind with sufficient strength to destroy fly larvae, is nothing less than an absurdly impracticable notion; it would indeed be impossible.

IT is true that, in certain well-paved and perfectly sanitary areas of limited extent in cities where there are no stables, and where garbage is collected so often that the insects in their developmental stages do not have time to attain the winged state, and where the streets are kept remarkably clean, flies are comparatively rare; indeed, there are often so few of them, even in hot weather, as to make them appear astonishingly absent. Only now and then does one drift through the unscreened windows to grace the table, its presence the result of its clinging to some bakery truck or groceryman's delivery car until

# FLIES



The magnolia warbler captures a green-head gad fly while on the wing

more delectable odors attract it. Then, suddenly, there will come a swarm of flies, but from what original source there is not even a chance of guessing.

More flies of all kinds are destroyed through the normal processes of nature than by anything man has devised. In the struggle for existence they are at times exceedingly susceptible to the attacks of numerous enemies. Flies are protected in the adult stages only by their wings; they are the swiftest of wing of all creatures, irrespective of proportionate sizes. They have no stings or defensive jaws, and their sucking apparatus is never, or rarely, used defensively. Simply by their remarkable fertility they far more than offset any destructive agency acting against them.

THE enemies of flies are not an interesting consideration economically, but only as objects of nature study; for, though they lessen the numbers of these pests, they have not done so appreciably within our experiences. If there were no natural checks to flies, perhaps human existence would be altogether intolerable. However, we can somewhat profitably study the habits of the flies' enemies. Whatever limitations there may be on the numbers of flies are due to many causes.

In this limitation birds are a factor, though of secondary importance because they can rarely catch the swift-winged adults of the stout-bodied Diptera, while they do not often see the nocturnal species. They get many mosquitoes that fly in the daytime, such as the salt water and woodland kinds, as well as those flies that have just emerged from the pupal stage and are still weak of wing. These feeding habits of birds also apply to dragonflies, robberflies, shrews, mice, lizards, snakes, toads, and salamanders, but are reversed in the case of bats, as these catch many mosquitoes but do not get the day-flying insects including the stout-bodied, swift-winged species.

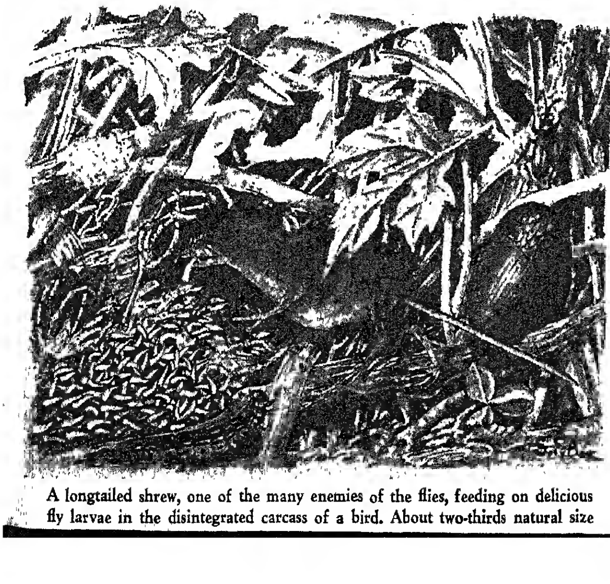
The birds that now and then pick up the muscid and tabanid flies are the true fly-catchers—the arboreal warblers, the vireos, and the very expert swallows and chimney swifts. Those birds that are gleaners, such as the nut-hatches, chickadees, terrestrial warblers, thrushes, bluebirds, orioles, finches and sparrows, woodpeckers, cuckoos and all the gallinaceous group, now and then obtain fly larvae and pupae, as do also the shrews, moles, and mice.

In this labor of destroying flies the omnivorous ants deserve much respect, but by far most important as enemies are those friends of mankind, the spiders. Because they destroy certain caterpillars which defoliate nearly all kinds of vegetation, several kinds of spiders are most essential to our welfare and actually necessary to our existence. Because of their destruction of flies they are scarcely less to be venerated. The common attitude toward spiders as creatures both horrid and harmful, is one of those frequent examples of ignorance based on no reasons whatever concerning most of the species and very little regarding any of them.

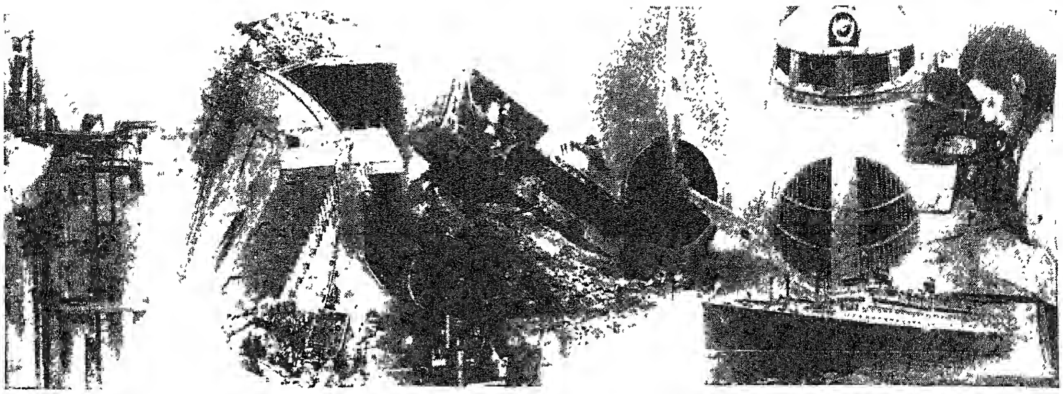
THE ground-hunting spiders get flies, much as do the shrews and birds; the web-makers, especially the orb weavers, get them coming and going, that is, both day and night. Even the strong-winged bee-flies, the largest and most powerful horse and cattle pests, and the pernicious green-heads cannot dodge the sticky snares, nor can the mosquitoes, which are quickly sacrificed on the blessed altar of spider engineering.

It has been suggested, because of the prevalence of the known enemies of flies, that an artificial increase of these forms might be advisable. This could be accomplished, but it appears never to be wise to interfere in any way with the balance of nature. We already have notable examples of this in the destruction of mouse and rat-killing hawks and owls; in the introduction of foreign species without their natural checks, and in the deplorable over-production of domestic cats.

Finally, the perennial hope of eradication of the mosquito has come to be regarded as something of a huge joke. The accepted definition of faith fits perfectly. After years of effort, following intensive propaganda; after such boastful results as have led to statements altogether untrue and even to the building of monuments to commemorate a supposed success, *Culex* and *Anopheles* still swarm, as may be fully proved, in their wide and chosen haunts.



**A longtailed shrew, one of the many enemies of the flies, feeding on delicious fly larvae in the disintegrated carcass of a bird. About two-thirds natural size**



# THE SCIENTIFIC AMERICAN DIGEST

Conducted by F. D. McHUGH

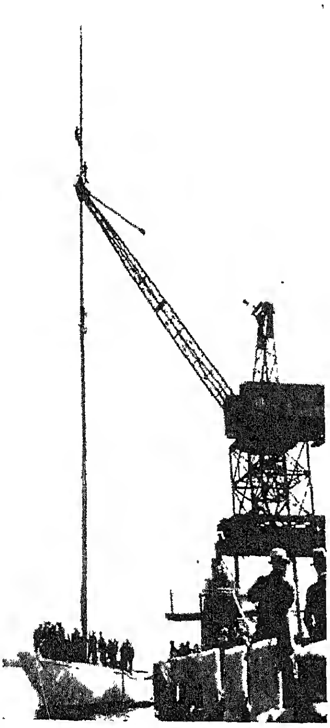
Contributing Editors

ALEXANDER KLEMIN
In charge, Daniel Guggenheim School of Aeronautics, New York University

D. H. KILLEFFER
Chemical Engineer

## AMERICA'S CUP DEFENDER "RANGER"

THE racing yacht *Ranger,* which will defend the America's Cup, embodies the latest principles of yacht design and construction. *Ranger* was designed by W.

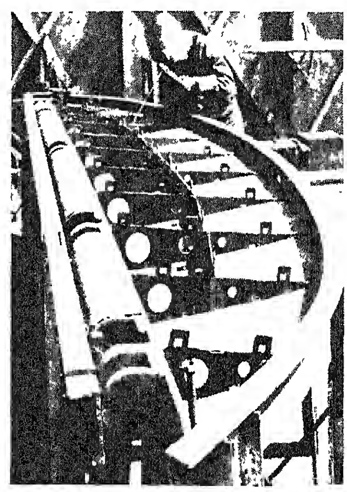


"Stepping" the 165-foot duralumin mast on the racing yacht *Ranger*

Starling Burgess, designer of the last America's Cup winner *Rainbow,* as well as the previous *Enterprise.* Mr. Burgess' father, before him, designed three America's Cup winners. Bath Iron Works, Bath, Maine, builder of many America's Cup boats, built *Ranger.* She is all-steel construction and utilizes arc welding extensively. The Lincoln Electric Company's shielded arc process of welding was used in construction.

*Ranger* is 135 feet 5¼ inches long overall and 87 feet at the waterline, 21 feet maximum beam, and 15 feet draft. Her mast—165 feet long, 22 inches by 14 inches at the top—will carry between 6000 and 7000 square feet of mainsail. To obtain the strength required to withstand the terrific stresses of this tremendous sail area, and to keep weight at a minimum, the mast was made of duralumin and the fittings were electric arc welded. To counterbalance the draw of her mammoth sails, *Ranger* has a lead keel weighing 110 tons, the heaviest ever used on an America's Cup boat. This tremendous weight is held in place by a flat keel plate of arc-welded steel. The stresses to which the mast and keel plate are subjected when *Ranger* is under way with all sails drawing are terrific, since the bending moment between the pulling sails and the gravitational pull of the keel weight is enormous.

In addition to mast fittings and keel plate, *Ranger's* stem, her rudder and stern frame are arc welded for greatest strength per pound of weight. The stem was fabricated of three plates 48 feet long, 4½ inches wide and ⅝ inch thick. Use of electric welding in construction made it possible to fabricate the stem to conform exactly to the lines of the hull. In previous boats, the stem had been cast to an exact pattern. With electric welding it was not only possible to obtain perfect form but the structure was considerably lighter yet much greater in strength.

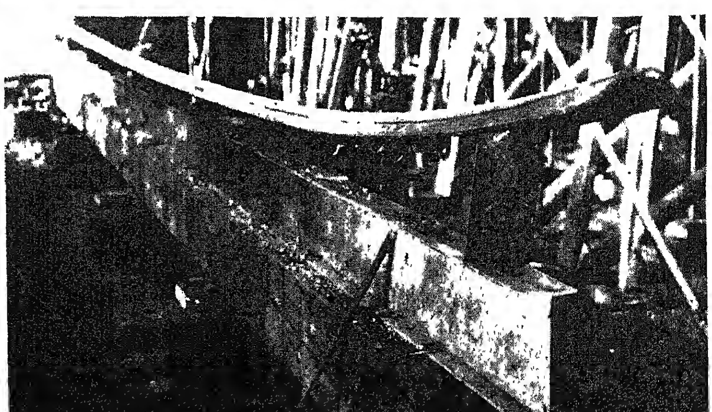


*Ranger's* rudder, four feet wide, was built up of arc-welded steel

*Ranger's* rudder, another part of her structure which must resist extreme stresses, is entirely weld fabricated. It is 13 feet in length and four feet maximum width. It consists of various steel shapes and plate cut to conform to designed size and form and then fused into a single unit by the electric arc.

*Ranger's* stern frame was fabricated entirely from flat steel plates arc welded together.

The new queen of American racing



yachts will race against the British contender to determine whether the famous trophy stays home or crosses the Atlantic in possession of the British.

### RUBBER

**MORE than 50 million rubber trees are required to produce the 75,000 to 80,000 long tons of crude rubber used annually in its products by one large rubber company.**

## Oil Films—Living Cells

AN important approach to the problem of simulating conditions in living tissue, that the difficulties encountered by these microscopic particles in their struggle for existence may be better studied, was discussed by Dr. Irving Langmuir, associate director of the research laboratory of General Electric, at the recent Mark Hopkins centenary at Williams College. In his talk, entitled "Two-Dimensional Gases, Liquids, and Solids," Dr. Langmuir described experiments with liquid films which have properties like those of a cell wall, thus creating in the laboratory substances which throw light on the behavior of living tissue. The research involved, conducted by Dr. Katharine B. Blodgett and C. N. Moore, is an off-shoot of a general investigation of the properties of oil films on water.

"We have recently been investigating," said Dr. Langmuir, "the intermediate field between acid and alkaline water, using solutions that are either neutral or slightly acid or alkaline. We also have investigated the effects of small amounts of calcium, magnesium, sodium, and potassium salts in water. We find that, in solutions which closely approximate sea water in regard to acidity and alkalinity and have similar amounts of dissolved salts, particularly interesting phenomena are observed."

These phenomena, he explained, indicate that certain types of oil films on water, where they make contact with each other, are, in many respects, very similar to a cell wall. In these experiments, Dr. Langmuir pointed out, "we have the advantage, however, that we can make this artificial cell wall cover a square foot if desired; we can study in detail properties which it would be very difficult to measure in a living cell.

"By quantitative studies, we can derive fundamental laws that govern these changes in properties. We hope, by following up this work, we shall be able to establish some principles that will be of great use to the biologist in understanding the complicated dependence of living cells upon the composition of the surrounding medium."

Dr. Irving Langmuir (right) demonstrating oil films to Dr. W. R. Whitney and Dr. W. D. Coolidge

## Polishing Pipe

UNAVOIDABLE imperfections in pipe formed of non-corrosive alloys widely used in industry must be removed if the pipe is to serve its purpose. A new machine polishes the interior of the tube, using a belt of coated abrasive similar to sandpaper. By this means the interior of the pipe is rendered as smooth and bright as the outside. —*D. H. K.*

## Home Electrolysis Depilatory Machine

SINCE the days of Cleopatra, women have been experimenting with depilatories and other methods of hair removal, but today as arms and legs take on a seasonal importance with beach days and modern swim suits, men and women alike are concerned with the permanent removal of excessive hair growth.

Beauty salons have been using for a number of years the method of electrolysis to remove excess face or body hair. Such treatment is very costly. Home treatment, much less expensive, has been made possible by the introduction of the Beautiderm Midget, a new home model of the professional machine which promises to remove hair painlessly, scientifically, and permanently. It is manufactured by the Beautiderm Company.

Equipment for home hair removal

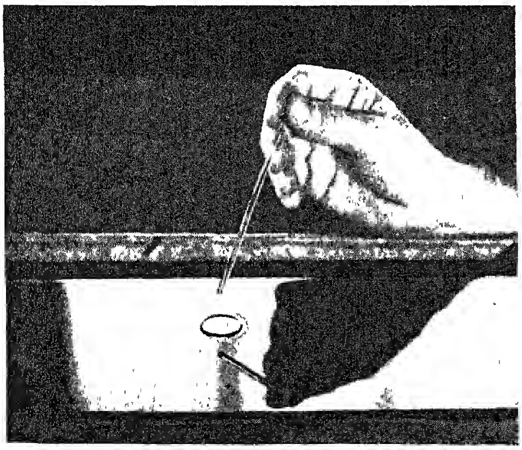
The Beautiderm Midget, which comes in three models, consists of a small cabinet equipped with a battery having a maximum of 4½ volts, an iridio-platinum needle of 1/7000 millimeter gage, a wrist electrode, small connecting wires for plugging into sockets in the cabinet, a bottle of antiseptic to be used before treatment, and a lotion for use afterwards.

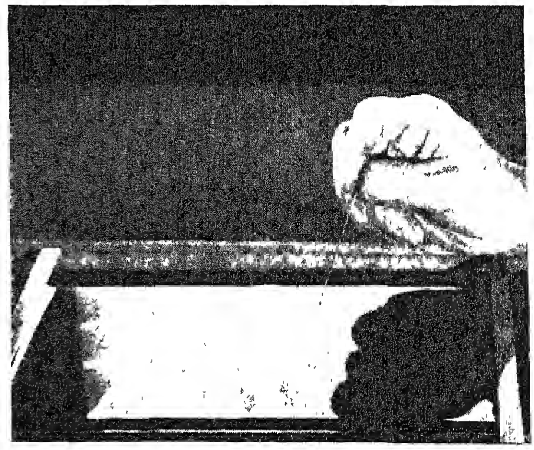
In using this machine, wire connections are plugged into the cabinet, and the wrist electrode, soaked in brine, is attached to the wrist. The rheostat dial of the cabinet is then adjusted for fine or coarse hair, and the needle is inserted into the individual hair follicle. The minute current which then flows destroys the hair at the hair root so that it does not return. The operation is then repeated with another hair about ¼ of an inch away. It will be seen, therefore, that only a relatively few hairs may be removed at one treatment.

These small electrolysis machines are low-priced, within the reach of the average person.

## Chickens Will be Envious

AMERICAN chickens are due for a shock when the National Geographic Society-Smithsonian Institution wild animal collecting expedition returns from Sumatra





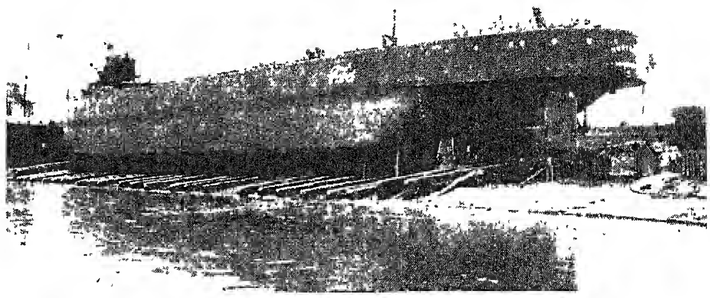
A "lens" of oil on water. An oil does not spread on water unless certain substances with an affinity for water are dissolved in the oil. *Right:* The dark areas are floating mono- are covered by oil (two-dimensional liquid). The two-dimensional solid film, which has great rigidity, was formed by spreading stearic acid on water containing tannic acid and

this summer. Among the menagerie of strange creatures which it collected are several Maleos, birds half as large as chickens but which lay eggs with 10 times the volume of hens' eggs (about 2⅙ times the diameter). The huge eggs are covered by mounds of earth and vegetable debris and left to hatch. When the young Maleos emerge they are all ready to fly and take care of themselves.

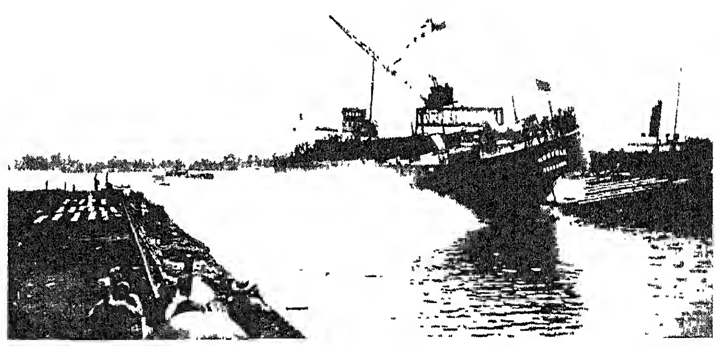
### Silk from Beanstalks

JAPAN'S growing production of rayon—she has lately become the world's largest producer—has forced her to seek domestic sources of the immense quantities of cellulose consumed by this industry. Attention has recently been directed toward the possibility of utilizing the stalks and husks of soy beans for the manufacture of their much needed raw material. Experiments have shown that a pulp containing more than 85 percent of alpha cellulose can be made from these by-products of the soy bean oil industry in Japanese-controlled Manchuria, and plants for its manufacture are planned with an initial production of 50,000 to 60,000 tons annually. Thus Japan seeks independence of foreign sources through bean stalks, just as Jack acquired fame thereby.—*D. H. K.*

# TRANSPORTATION SECTION



*Above:* **The largest all-welded ship ever built in a Great Lakes shipyard, and** *below*, **the 300-foot vessel photographed when she first entered the water**



### Large Welded Lake Steamer

LAUNCHED June 5 at the River Rouge, Michigan, yard of the Great Lakes Engineering Works was the second of two unique arc welded 300-foot ships, largest ever built in a Great Lakes shipyard without rivets. The illustrations show the vessel ready for launching and being launched. For operation on the Great Lakes and through the New York State barge canal to Atlantic coast ports, this craft and her sister ship can carry 300 tons more cargo than the same size riveted vessel.

The vessel is 300 feet long, 43 feet beam, and 20 feet deep. The design for arc-welded construction was the work of Gielow, Inc., New York City, naval architects and marine engineers, in conjunction with the shipyard. The vessel is transversely framed to comply with the rules of American Bureau of Shipping. Power will be supplied by two eight-cylinder, four-cycle, 600-horsepower Cooper-Bessemer Corporation Diesel engines driving the twin-screw propellers.

The use of electric welding in construction permitted fabrication of the hull in complete sections in the shop. An advantage of electric welded ship construction, this method permits fast assembly and considerable economy.

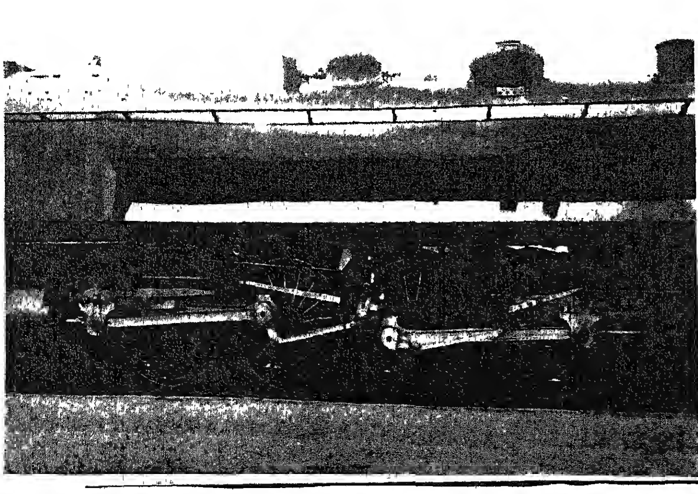
Commenting on the launching of this vessel, A. F. Davis, Secretary, The James F. Lincoln Arc Welding Foundation, Cleveland, Ohio, said: "With its increased cargo carrying capacity, this arc welded ship will save its owner thousands of dollars each year. A proportionate increase in the capacity of each new vessel built will permit tremendous savings to the shipping industry. It is to encourage, throughout industry, the sort of progress here illustrated, that the Lincoln Foundation is sponsoring a 200,000-dollar national award program."

### First 4-4-4-4 Steam Engine

FEATURING the latest in locomotive design and construction, the Baltimore and Ohio Railroad exhibited recently the first 4-4-4-4 type, 4-cylinder, single-unit, single-expansion steam locomotive ever built.

Named the *George H. Emerson*, in honor of the present chief of motive power and equipment of the B. & O., the new steam engine was completed on June 3 in the historic Mount Clare shops of the company in Baltimore from plans prepared by W. B. Whitsitt, assistant chief of motive power and equipment, and his staff.

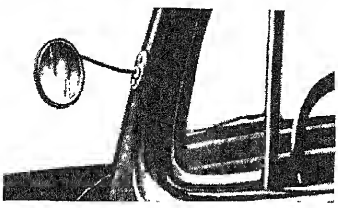
The locomotive was designed for passenger service but can also be operated in high-speed freight service over the main line from Jersey City to Chicago or St. Louis. Since its completion it has more than fulfilled operating expectations in road tests



new No. 5600 steam locomotive is the Emerson water-tube boiler which enables the fire-box to develop the steam capacity needed for the four cylinders at 350 pounds pressure. The superheater is of unique design and the valves are double-ported.

## Attach Auto Mirror Without Drilling

SIDE-VIEW mirrors for automobiles are not new. One recently put on the market, however, is unique in several respects. First of all, it may be attached to the side door of a car in three minutes or less, without drilling and without special tools. Secondly,



Easy to install

it is permanently in place and theft-proof. The mirror is held by a molded rubber rim which prevents moisture from getting behind the mirror and peeling the reflecting surface. Perhaps best of all—it is very inexpensive.

## Motor Car Lubricants —1937 Style

WHEN hypoid gears were first developed for automobile rear-ends, it was thought they could not be used because there was no grease then known that would lubricate them. The design of these rear-axle gears is such that forces between the bearing surfaces of the teeth are more violent than in prior differentials. However, research brought out a rather surprising fact. Those lubricants which contained sulfur—formerly carefully avoided in automobile oils and greases—were found to be better than oils in which this supposedly deleterious element was absent. Trials with compositions containing added sulfur revealed that unusual lubricating properties could be obtained. If the sulfur is used in the form of one of its more stable compounds, or is otherwise properly prepared, not only does it not destroy the gears and bearings but it acts as a positive deterrent to wear. Initially a tenacious layer of sulfur compound is laid down on the gear teeth by reason of the chemical activity of the sulfur. Then chemical activity stops. Whatever happens from there on, it has been proved beyond any shadow of doubt, by laboratory and road tests, that the hypoid gears so coated will not tear themselves to pieces as they will with ordinary oil.

Two explanations have been given. One holds that the sulfur film acts simply as a separating means, preventing metal-to-metal contact. This view is based on the fact that if the bearings can be kept apart, scoring and welding are prevented. The other theory maintains that metal-to-metal contact is unavoidable, but that if it is momentary, no damage will be done. On this basis it is suggested that the interposed lubricant film actually does break down at points on the faces of the intermeshing teeth but that the

speeded up by the developing heat at the point of greatest friction, is sufficient to cause the compound to replace the broken film instantly and effectively.

Whatever the true explanation may be it has been established by extensive experiments on lubricant testing machines that sulfur is a desirable "extreme-pressure" agent. That is, it greatly increases the capacity of an oil film to hold surfaces apart. Ordinary mineral oil films on bearing surfaces break down at comparatively low pressures. With sulfur added, the load-bearing ability is greatly increased.

The efficacy of sulfur suggested the possibility that other substances might work. Compound after compound has been tried and found successful. Among the most promising groups are the compounds of phosphorus. Tricresyl phosphate, known as an ingredient of lacquers, has proved itself a high-powered lubricant.

It is apparent that something of a revolution has been wrought in ideas of lubrication. From strictly neutral to definitely active oils is a decided change in practice. Already engineers have extended the chemical film idea toward chassis and even engine lubrication. If a guess could be hazarded it would be predicted that the era of pure mineral-oil lubrication is drawing to a close and that tomorrow will see lubrication controlled by a whole series of chemicals perhaps culminating in the virtual abandonment of mineral oil. Just as the latter displaced fatty oils, so is petroleum itself subject to replacement when new and better compounds are found. If superior lubricants are discovered they will be used, though what form they will take, who can say?—*J. Harold Byers.*

## PRE-FORMED RUBBER EXPANSION JOINT FILLER

A NEW type of rubber expansion joint filler for all conventional joint openings used in concrete highways, structures, curbs, sidewalks, tanks, and other miscellaneous types of construction has recently been introduced by The B. F. Goodrich Company.

These pre-formed strips are made of rubber specially compounded for best aging and wear-resisting qualities. They are designed with flexible lips on the two sides, which project upward against the concrete surface of the joint opening, making their removal very difficult. In order that the strips

The rubber expansion joint filler

Close-up of the expansion joint filler, showing fins and hollow center

may be easily compressed, they are made with a large tubular opening in the center. The top surface is slightly indented or grooved to provide for downward thrust of surface upon compression. Due to this latter feature, it is impossible for material to extrude above the wearing surface of the pavement.

The strips are designed to be placed under partial compression as they are made about 25 percent wider than the opening in which they are to be used. This permits the rubber to follow the concrete as it contracts and yet compress readily when the concrete expands.

Advantages claimed for this new preformed rubber expansion joint filler are that it eliminates expensive joint maintenance work; is low in cost; entails no waste through trimming; cannot be damaged by ordinary handling; is quickly installed by unskilled workmen without aid of special tools.

## Lighter Freight Cars?

If it were possible to eliminate one fourth of the weight from the 1,745,299 freight cars owned by American railroads, a saving of 154,000,000 dollars would be effected in their operating costs during the current year, Albert F. Stuebing, railroad mechanical engineer of the United States Steel Corporation told the New York Railroad Club recently.

Mr. Stuebing was quoting Mr. Ralph Budd, President of the Burlington Lines, who had recently compiled some figures based upon estimates of the Car Service Division of the Association of American Railroads.

Quoting Mr. Budd further, Mr. Stuebing continued: "The cost per ton mile of moving these cars, not counting their contents, is estimated to be 1.13 mills.

"If these cars weighed one fourth less, there would be a saving of 113,561,806,000 ton miles which, at 1.13 mills per ton mile, would amount to 128,324,840 dollars.

"Following the assumption that 1937 would see 20 percent more business moving, the saving could total 153,989,808 dollars were it possible overnight to reduce the weight of all freight cars by one fourth."

Although steel has always been synonymous with strength, stronger steels are the answer to the problem of reducing deadweight to cut railroad operating costs, Mr. Stuebing declared.

As far back as 1928 the United States Steel Corporation started pioneering in research for a high-tensile steel which would combine superior strength with a marked increase in endurance under service condi-

# THE AMATEUR TELESCOPE MAKER

**Conducted by ALBERT G. INGALLS**

CHATTANOOGA, TENNESSEE. has more amateur astronomers to the square inch than most American communities, perhaps because it has long been the home of the Barnard Astronomical Society (Barnard, the keen-eyed photographer's assistant who became a noted professional astronomer at Yerkes was a Chattanoogan) and is therefore telescope conscious. Clarence T. Jones, 210 Glenwood Drive, Chattanooga, an architect by vocation and an amateur astronomer and telescope maker by avocation, is the president of the society, and has been fathering and directing the construction of a city observatory (Figure 1), for which he was the architect. Within the dome is to be a 20¾" Cassegrainian reflector (Figure 2) designed and built by Jones and his sons Clarence and Bruce, assisted by Paul Lewis. Before tackling the 20¾" job Jones, senior, made over 25 smaller mirrors.

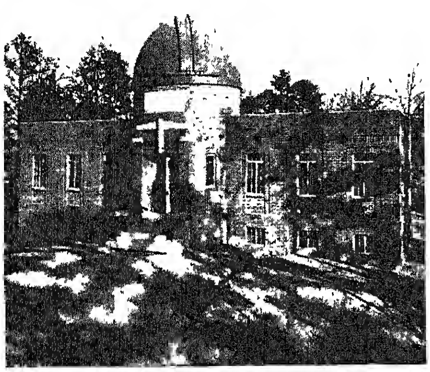


*Figure 1:* Property of Chattanooga, Tennessee

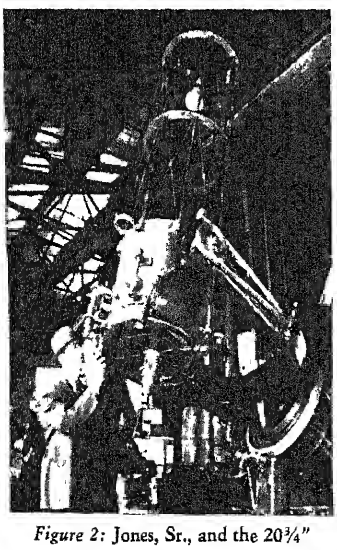


*Figure 2:* Jones, Sr., and the 20¾"

The mirror was made on the machine shown in Figure 4, where the disk, 2½" thick, is shown while being perforated. Central spindle, 3 r.p.m., side cranks 40 r.p.m. and 1 r.p.m. Figure 3 shows the preparation of a plaster-backed polishing secondary. The lap was made by the Ritchey method—pouring pitch between ¼" strips of wood laid on newspaper. Cross marks were pushed into the strips before the pitch cooled, and the strips were broken into squares on hardening. The squares were later heated enough to detach the newspaper and applied to the disk, which was already covered with HCF, and others were similarly applied to the main mirror (Figure 5). An excellent method of supporting a mirror for test, devised by the late Henry H. Mason of Florida and once illustrated in these columns and used by Jones, is shown in Figure 6. A crank behind the board permits rotation of the spool and belt to bring any diameter of the mirror to a vertical.

Jones spent a year planning this telescope, making 15 detailed drawings. To make the main mirror took one month of day and night work. Iron tools were used for grinding. Polishing took 27 hours, figuring 30 hours, and at no time did the mirror misbehave. The secondary is a 5½" convex.

FROM Cyril G. Wates, 7718 Jasper Ave., Edmonton, Alberta, Canada, we have received the following item pertaining to the telescope making art:

"With the Foucault test nearly eighty years old, it is hardly likely that anything connected with it is actually new, but speaking for myself, there was always something lacking in the precision of the test until I made the discovery that by sliding the knife-edge *along* the optical axis instead of *across* it, I could watch the shadows change from right to left, and thus determine the exact focal center of any zone.

"In order to slide the knife-edge along the axis with absolute precision an adjustable guide must be provided with means for moving the edge laterally without affecting the parallelism of the guide and the axis. I built a rather elaborate machine with micrometer adjustments, right-angled prism, and so on, but nothing of the sort is really necessary. A strip of wood screwed down to the table, a large block to slide along it, and a knife-edge mounted on this block in such a way that, by turning a screw, the knife can be moved in and out—that is all. The essential point is that the whole thing must be movable *exactly* along the optical axis.

"In actual testing, I start inside the focal center and work toward me; then start outside and work in. I find that there is rarely more than 0.01 of an inch difference, even on central zones. I have completely refigured my 9" mirror, using this method, with the result that I can easily split double stars which were formerly quite hopeless. The advantage of this method is that you watch the shadow continuously and can easily determine the point at which it reverses, while the customary method requires the observer to judge a fixed appearance. It is the same difference as there is between a motion picture and a series of photographs."

FOLLOWS a second item by Wates:

"The contributions of J. H. Hindle and others in ATMA on the construction of diagonal mirrors for Newtonian telescopes leave little to be desired, but for the benefit of those who, like myself, hesitate to attempt the edging and figuring of a truly elliptical flat, the following considerations are submitted.

"Diagonal mirrors are generally made either elliptical or rectangular. In either case, the blank must be edged to size and then provided with a 'surround' of similar glass before attempting to figure the surface to a true plane. To these shapes may be added a third, viz., circular with straight edges. Let us see what is the loss of light due to the use of each of these shapes, taking a 12" mirror with a focus of 96" as an example.

"The correct size for an elliptical diagonal will be 2" by 2.83". The area of parallel rays intercepted will be that of a circle 2" in diameter, or 3.14 sq. inches. Assuming glass ⅜" thick, a rectangular diagonal will intercept a rectangle of rays 2" by 2.3", allowing for the protruding lower edge, which could, of course, be ground off if desired.

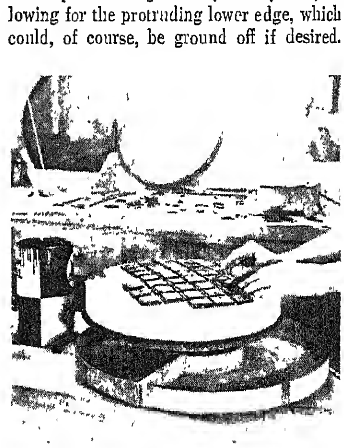


*Figure 3:* The chocolate fudge lap

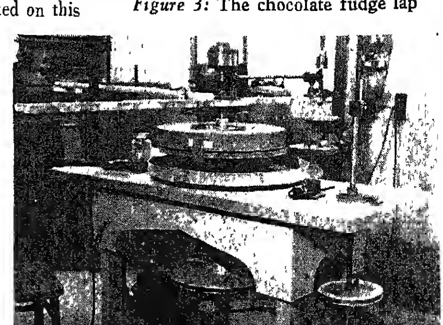


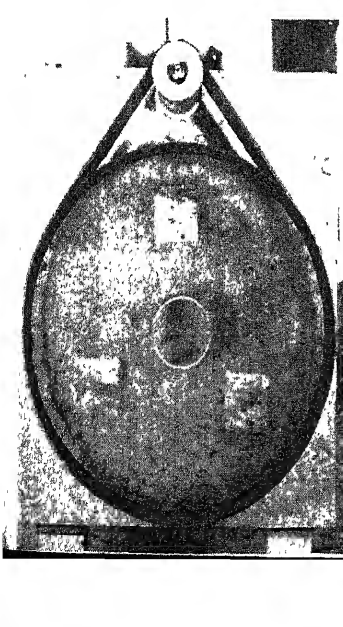
*Figure 5:* Trimming the main lap

This area will be 4.60 sq. inches, which is 1.46 sq. inches greater than that of the ellipse. The effective area of the O.G. being 110 sq. inches (approx.), there will be a loss of light of about 1.3 percent. which is equal to masking off a strip around the edge of the mirror .038" wide—or about 1/32".

"How about a circular diagonal? Again allowing for the square edges, the rays intercepted will take the form of an ellipse, 2.83" by 2.30", with an area of 5.11 sq. inches. As compared with the elliptical mirror, this represents a loss of light of 1.8 percent, equal to a strip .052" wide around the edge of the O.G. As compared with the rectangular diagonal, the circular one causes a loss of light of only 0.5 of 1 percent, or an amount equal to grinding away 14 thousandths from the edge.

"These differences are so small that one is led to the conclusion that the labor involved in constructing a truly elliptical diagonal is sheer waste of energy, and that a circular mirror which can be polished and figured without elaborate complications is perfectly satisfactory in all but very short focus telescopes. Certainly the difference in performance between a 12" mirror and one having a diameter of 11.948" is hardly justification for the work involved."

FIVE men in Providence, Rhode Island—Prof. C. H. Smiley, mathematician-astronomer of Brown University, Donald S. Reed, Harry A. MacKnight, Paul Eberhart





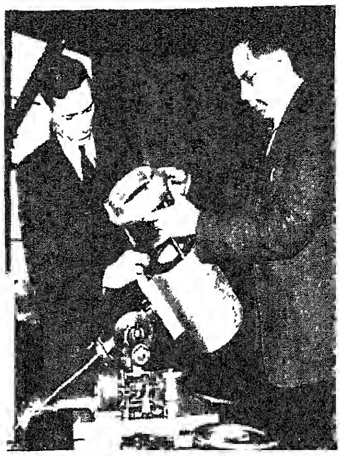


*Figure 7:* Hoffman, Schmidt, Eberhart

*Figure 8:* The schmidting machine

and Frederick C. Hoffman—have made a 6" Schmidt camera shown in Figure 7. The tube is shown inverted, Hoffman (right) has his thumbs on the mirror cell, his little finger on the film supporting ring, and Eberhart (left) his fingers on the ring for the correcting plate. Figure 8 shows the special machine by which these workers solved the problem of the difficult, irregular, knock-kneed, bow-legged, psychopathological curve on Schmidt correcting plates. Asked to describe this creation Reed wrote:

"Mr. MacKnight designed and built the grinding and polishing machine for the Schmidt correcting plate or lens. The plate was cemented in the Bakelite ring on the turntable and turned slowly by motor. A fine emery wheel rotating at right angles was used in grinding, and a similar wheel of wood with pitch on its edge was used with rouge for some of the polishing. The handle at the end of the long screw for radial movement moves the grinding wheel from center to edge of the lens. The depth of the cut is adjusted by a micrometer.

"The shape of the lens face was tested with a dial indicator measuring to .0001". Ring laps with No. 600 Aloxite and rouge were used for final grinding and polishing. As you suggested, we used a Borium tool to rough out the deep curve of the spherical mirror and its tool on a lathe."

In Figure 8, MacKnight is nearest the reader, adjusting the abrasive wheel of the machine, Hoffman sits behind, while standing at the back, with the $f/1$ mirror in his hands, is Smiley who has led the project—to designate in this column men of different vocations who make telescopes is often a problem. As amateurs in a hobby they are all equals and so they are all simply "Smith", "Jones", "Brown" and so on whether billionaires or paupers, old or young, doctors, professors or water boys—which we believe to be as they would best like it.)

RESIDENT in China is C. N. Joyner, address "P.W.D., B.M.C., Tientsen", an American civil engineer who built the telescope shown in Figure 9 and with it made photographs of the moon, and with these illustrated a book reviewed elsewhere in this number. Figure 10 is the homemade camera with which these lunar photographs were taken. It consists of a film-pack adapter connected to a Thorndyke shutter, the whole screwing into the eyepiece holder of the telescope. Joyner has two mirrors, a 10" made by himself and a 12" Hysil mirror made by H. E. Dall of England, each of 100" f.l. His own four previous mirrors were roughed out using oil instead of water. The telescope tube is of plywood; the base has a run-off shelter. Beside Joyner in the photograph is his son Nicolas whom he describes as the "Gastronomer" or "Assistant Director of the Observatory in Charge of Gastronomy". (At about the same hungry age your scribe's initials were parodied within his family as "All Gone Inside".)

FIGURE 11 is an 8" made by C. E. Raible, Seavey Road, Milvale, Pa. The mounting

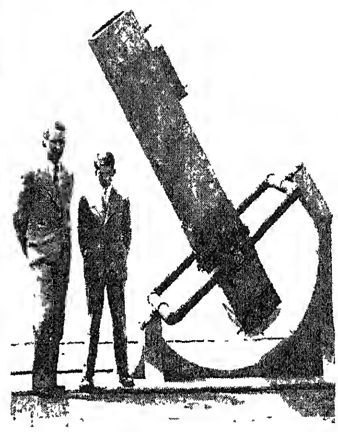
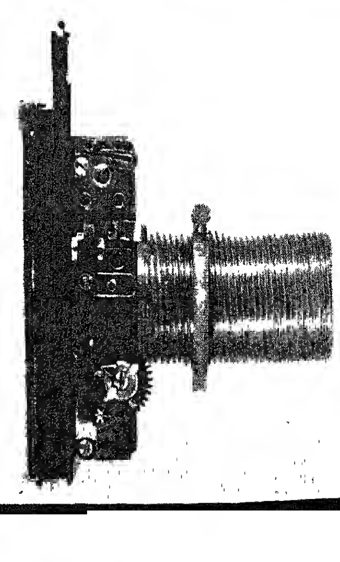


*Figure 9:* Joyner, Joyner, Jr., and 10"



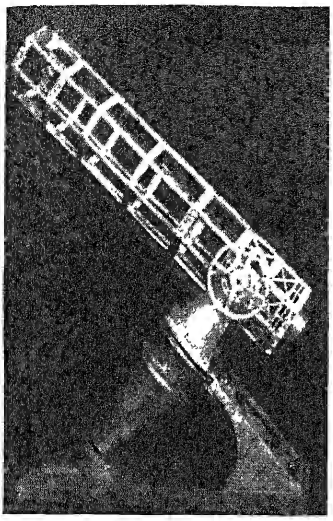
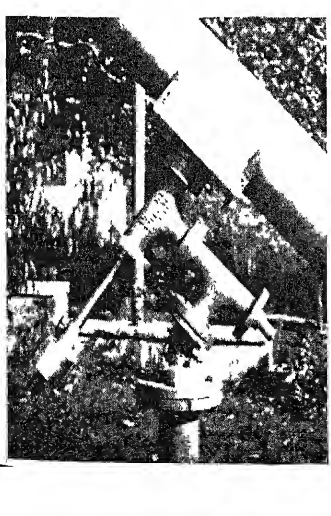


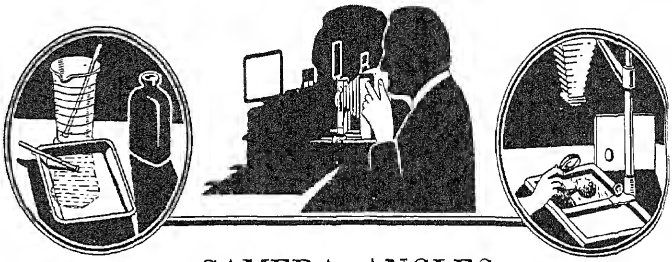
*Figure 11:* Raible's "Old Rigidity"

is based on an illustration of one of the designs that were proposed for the 200" telescope. Raible made the drawings, patterns, castings, and did the machining.

FIGURE 12 is a mounting by C. E. Mielke, 235 Princeton Avenue, West View, Pa. It is made of pipe fittings but not ordinary pipe fittings. Mielke describes it thus: "The castings are standard 1¼" flanged pipe fittings faced but not drilled. This size is suitable for a 6" or 8" telescope mirror. For a 10" mirror 2" fittings should be used. As they are rough cast on the inside, the two tees are bored 1½" deep at each end and bronze bushings driven in. This gives the shaft a bearing at each end and also the large surfaces of the flanges are in contact, which makes for smooth operating and rigidity. The polar axis is a drive fit in the tee, so that the shaft turns with the tee."

YEARS ago W. H. Pickering and others described mysterious and periodic changes in size, shape, and color of certain lunar markings. Amateurs watched these but in later years observation largely lapsed. Now three excellent summaries of this subject, in the June-July number of *Popular Astronomy* (Northfield, Minnesota), bring it to the front again, and definitely describe observations that amateurs can make with plain equipment. Who knows—there may be marigolds on the moon, after all!





# CAMERA ANGLES

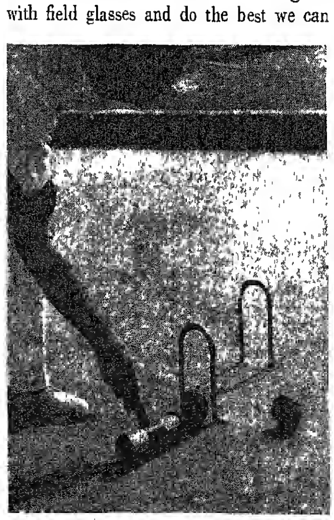
Conducted by JACOB DESCHIN

## Close-Up Sports Photography

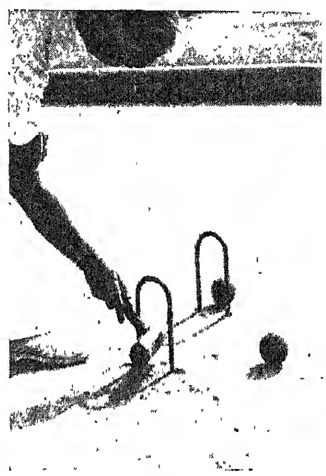
YOU can't beat the close-up for real story-telling quality. There's nothing like it for punch and clarity. Here in a completely segregated area, entirely removed from all that is going on about it, singled out, restricted, is the whole thing in a nutshell. You know what is happening and how it is happening because you're right on top of it and can therefore see it all clearly.

Close-ups are effective with many subjects in photography and particularly so with sports and games because what is happening is of prime importance. Action is going on all the time, movement is the theme. In order to follow the game intelligently we must see the details of the action. Where is the ball? How was it struck or thrown? How did the player get out of that fix? It is fascinating to watch the ball flying through the air or rolling over the ground because of the element of suspense involved. But why do we feel this suspense? If by some miracle the ball were to fly through the air or roll over the ground continuously, without halting anywhere, we would very soon tire of watching the game. What we are chiefly interested in is the impulse that actuates the ball's motion, on the one hand, and, on the other, whether it arrives at its destination and how.

At ball games, football, and other sporting contests in which the action is necessarily spread over a large area, it is difficult to follow these details camera-wise unless we use a telephoto lens. Sometimes even a telephoto lens is not enough, so we are content in the main to watch the game with field glasses and do the best we can photographically to record the game in the mass.



Roque (1)



Roque (2)

However, such games as golf and tennis and indoor games like billiards and badminton allow many opportunities for obtaining close-up shots that really mean something. Often, too, they have a pictorial feeling about them distinct from their value as records of the game's progress. On this point of pictorial effect, we would like to place special stress. After all, unless we are sports photographers assigned by a newspaper to "cover" a game and never mind the flowers, we should strive to make only those shots that look good as pictures as well as being important incidents in the game.

Not all important incidents, of course, make worth-while photographic shots from the pictorial viewpoint. So if you're out to make a record of the game, blaze away to your heart's content. You will probably be able to get enough pictures out of the harvest to make a fairly presentable series to show afterwards to your friends.

Wherever possible, however, better than a series of disconnected incidents will be groups of progressive steps in separate incidents. One such incident is described in the three photographs accompanying this discussion. The game played is known as roque, a form of croquet, and is ideally adapted to the close-up since it is played within an unusually small court. The three pictures constitute progressive steps in the ball's movements. The first shows the mallet poised for one of the most difficult shots in the game, that of driving the ball through a wicket which gives the ball a clearance of about ⅛th of an inch on each side. The second picture shows the ball moving through the second wicket with the mallet

(Please turn to page 174)

Roque (3)

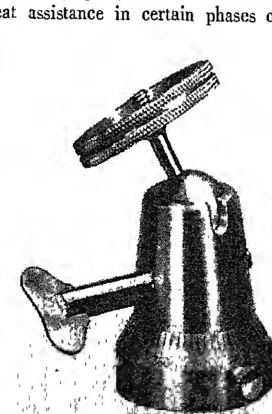
caught at the peak of its swing through the first wicket. The third picture shows the ball in actual motion as it comes through the second wicket. This last was, of course, taken in a repetition of the same incident, but does, nevertheless, constitute a definite part of the series. The last picture, incidentally, illustrates the pictorial type of picture discussed above. Notice how the motion of the ball contrasts with the rigidity of the non-moving ball in the foreground.

## Pola-Screens for Amateur Cameras

By means of a range of adapter rings, Pola-Screens may now be fitted to the lens mount of practically any camera. Separate lens hoods are also available. These screens are known as Type 1A and come in four sizes, designated as Series V, VI, VII, and VIII. While our readers are already familiar with the characteristic of these screens—that of cutting out glare and reflections—they will be interested to learn that, when using Kodachrome to make pictures in natural colors, subjects can be made to stand out strikingly against a dark blue sky. This method of darkening the sky, incidentally, is the only one possible in color photography.

## Tilt Top for Your Tripod

An interesting gadget for the amateur photographer, and one that will be of great assistance in certain phases of his



work, is the Tilt-O-Rama tripod top that is being distributed in this country by Henry Herbert, New York City. This device has a swivel top and graduated panoramic scale, both of which may be seen in the illustration. The moving parts may be locked rigidly in position, after they are once set, and will support even large cameras securely and safely.

The adjustable tripod top is light in weight, being made of aluminum, and will fit any camera and tripod with standard socket and screw. The graduated scale is of great help to the photographer when making landscapes, and can be readily utilized in many forms of "trick" work.

## Fascination of Silhouettes

THE beauty of the silhouette was appreciated long before photography came upon the scene, but a scissors cut-out of a profile is far inferior to the photographic silhouette in many ways. The slight suggestion of form that is often obtained by photographing objects or persons against a bright light gives a feeling of life not obtainable in a straight cut-out or even the completely black, sharp-edged photographic silhouette. In "Waiting for the Bus" we have a real silhouette; that is, we see outlines but not faces. Nevertheless, the highlights on shoes and hats and dresses, on the upraised arm of the woman in the flowered dress and on one of the packages of the shopper give body and shape while retaining the silhouette effect completely. The shot was, of course, from an elevation and the picture was made in late afternoon.

"Waiting for the Bus"

## The Rectifier Enlarger

WHEN a couple of camera enthusiasts get together and start ripping up existing notions about the construction of this or that type of apparatus in order to plan it closer to their collective heart's desire, you can expect almost anything. And

whale into is the usual enlarging camera.

Take the case of the Rectifier Enlarger, the joint enterprise of Joseph M. Bing, F.R.P.S., pictorialist and authority on photographic exposure, and Adolph Fassbender, F.R.P.S., pictorialist and instructor in photography. Feeling the need for an enlarger completely free of restrictions, and therefore constantly on the alert for every wish and whim of the pictorialist, the designers got to work, using for a base an original Austrian design. They had in mind a few friends of similar tastes to theirs—pictorialists, salon exhibitors, men and women in the advanced category of amateurs. They would make a few of the outfits and distribute them among their friends at a moderate price and without benefit of dealers. And so they did and so they are doing.

The Rectifier hangs against a wall, leaving the easel free to turn handsprings, if need be, in the cause of original pictorial treatments, for in the Rectifier it is the easel, not the housing, that is moved up and down for varying the size of the image, this raising and lowering of the easel being controlled by a counter-spring arrangement. The 18 by 18-inch easel revolves at the center from two supporting arms jutting out from the enlarger framework and may be used on either side, with a metal masking easel on one and with flexed spring clips on the other for "bleed" enlargements.

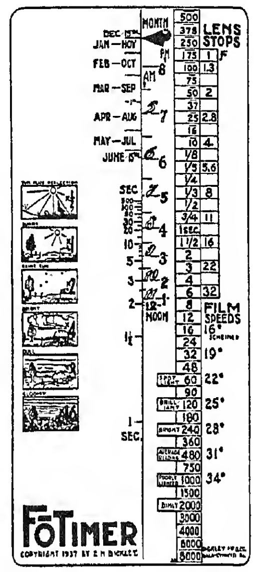
The Rectifier is equipped with a tilting negative holder in a turn-table device which makes possible a quick shift in the negative image, a change from a vertical to a horizontal position being effected without removing the holder. As the negative holder is tilted the housing is tilted with it, thus insuring correct and even illumination at any angle. The lens board takes lenses of various focal lengths interchangeably and, since the lens board is designed on the principle of the rising and falling front of the camera, the lens may be shifted about in various directions within the full 360°.

## "Modern Angle"

Exercising once again our proclivity for showing off, we present again a photograph of ours that has graced the walls of an exhibition hall. The picture is called "Modern Angle" and was taken in a triple mirror situated at sidewalk level below a store window front. We hasten to explain this right away just to head off the super critics who will at once note that the lettering visible in the picture is reversed. Incidentally, it took several exposures to get one that satisfied, because the scene kept changing all the time and it was necessary to get the right type of subject in the off-center position.

## Slide-Rule Meter

Believed by its sponsors to be a new thing under the sun, the Fotimer exposure meter is now on the market. The left-hand side of this so-called slide-rule




meter is devoted to the scales for determining variations in light conditions, while the right-hand side is devoted to applying this information to film speeds and lens stops. The makers of the Fotimer claim their meter is the synthesis "of thousands of tests, by numerous experimenters, covering long periods of years, not only on photographic film but also in connection with

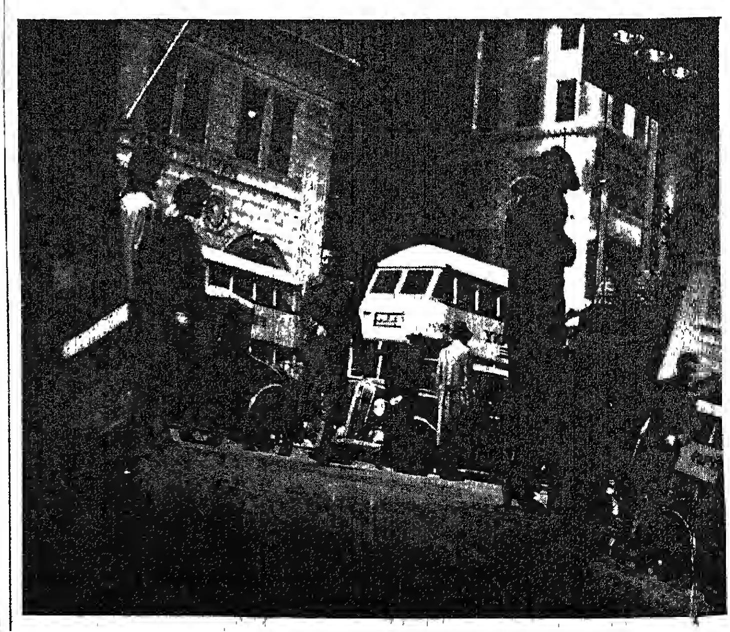


photo-electric cells of special sensitivity corresponding to that of photographic film." Directions for using the Fotimer are on the back of the slide, which is made of celluloid. Fotimer is made in various models to suit conditions in various latitudes.

## Hint for Bromoilists

EXPERIENCED workers with the bromoil process suggest the use of the P. U. Opal Glass Palette for mixing and spreading bromoil pigments before applying the ink to the print itself. Its advantages are that the white base of the Palette affords the opportunity of judging color blends, prevents the carrying of clumps of pigment to the print and indicates when the ink is practically exhausted. Also, because the Palette is relatively heavy, it will not be accidentally picked up by the brush because of the tackiness of the ink.

## Announcing the Mini-Photoscop

TAKING the camera-world completely by surprise is the recent announcement of the appearance on the market of a new photo-electric exposure meter distinguished principally by three features: 1. An electric cell of extraordinary sensitivity; 2. An instrument so small that it fits snugly in the palm of the hand, yet is accurate and rugged for all its compactness; 3. An unprecedentedly low price for a photo-electric exposure meter. The new meter is known as the Mini-Photoscop because of its small dimensions, its size being, in fact, about that of a package of cigarettes. It comes equipped with an ever-ready case, the cover of which also serves to protect the meter, when in use, against foreground reflections.

A feature of the Mini-Photoscop that should recommend it to many is the fact that it may be operated with one hand, both for aiming the meter and setting the knurled dial, irrespective of whether the meter is held in the left or the right hand.

By a slight shift of the knurled dial, on which the indelible scale markings are large and clear, readings are instantly made for still photography, motion picture work, or color photography. The meter is aimed and read in the same position as a book, the top-light influence being excluded and the reading angle restricted to less than the ordinary camera lens field, thus ensuring a correct reading for the subject.

## Projector for Miniature Positives

THE popularity of Kodachrome and Dufaycolor natural color film among 35-mm camera users makes the ownership of a projector for viewing the resulting color transparencies as urgent as the need for a projector in motion picture photography. The announcement of a new projector by E. Leitz, Inc., makers of the Leica camera, is, therefore, welcome news. The new projector, known as the VIII-S, is claimed by its sponsors to give an image brilliant enough for moderately large gatherings, yet fully adapted for home use. The VIII-S uses a 250-watt bulb, will project single frame filmslides, double frame filmslides or 2-by-2-inch glass slides.

## THE SCIENTIFIC AMERICAN DIGEST

(*Continued from page* 167)

tions. These efforts were successful and in 1934 an outstanding steel was introduced under the trade name Cor-Ten, now the leader of the corporation's high-tensile family. Two pounds of this steel will ordinarily do the work of three pounds of plain steel.

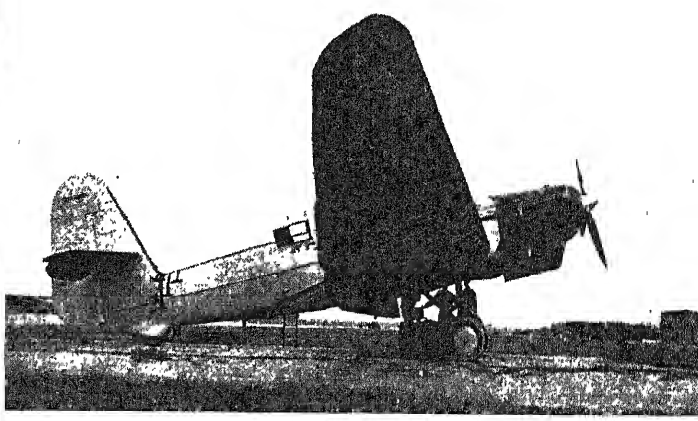
Herein lies one key to weight reductions and the means of effecting savings by the railroads. This high-tensile product is not only stronger than ordinary steel, but also more resistant to corrosion. Hence, thinner sections can be used in freight and passenger cars to give an average saving of 33 percent in the weight of structural parts. By thus eliminating costly deadweight from rolling stock, railroads can haul longer passenger trains and speed up their service. More pay load can be earned in freight equipment, with a substantial contribution to net earnings.

*(End of Transportation Section)*

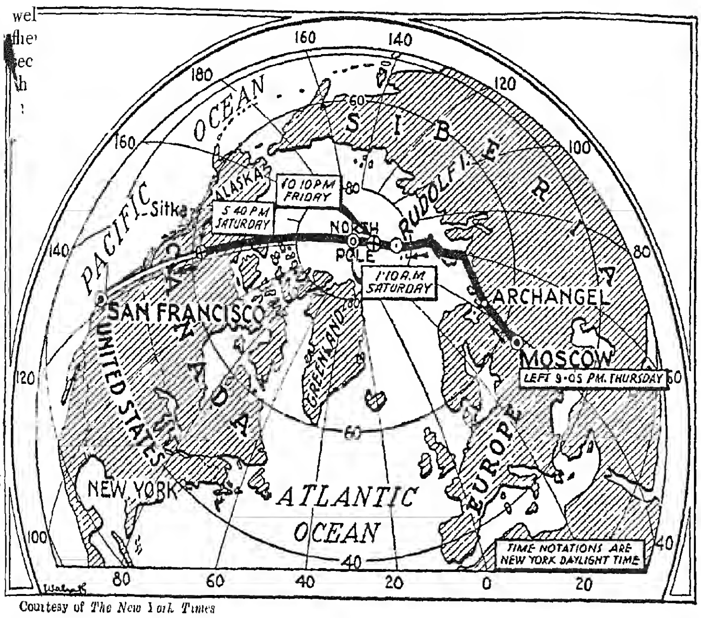
### Significance of the Moscow-U.S. Flights

WHILE the Soviet fliers from Moscow did not get to Oakland, California, on their first trans-Polar flight, but had to stop at Portland and continue their journey prosaically as passengers on another aircraft, and while they broke neither the long-distance flight record, nor the record of the longest non-stop journey, their achievement is nevertheless a remarkable one. Perhaps the readiest way of grasping the significance of the flight is to glance at the appended map and to compare the length of their journey with the distances of a possible journey from Moscow to California via Siberia and the Pacific Ocean. There is no doubt that if the West Coast of the United States is ever to be directly connected with the center of the Soviet Republic, it will be over the North Pole, taking "a short cut over the top of the Earth." The flight is all the more remarkable when the uncharted and unbeaconed territory is taken into account, as well as the tremendous difficulties of navigation in a region where magnetic indications are as uncertain as they are at the North Pole, where magnetic lines converge and cross in the most confusing manner.

The view of the ANT-25 indicates a robust and well proportioned airplane admirably adapted for its special task. Many wind-tunnel tests, careful vibration computations, and many trial and long-distance flights preceded the great exploit. The plane is 44 feet long, 18 feet high and has a wing spread of 122 feet. The wing area is 946.8 square feet. The weight empty is 9240 pounds, and fully loaded the wing loading is 26.24 pounds per square foot. The engine, Russian built, develops 950



*Above:* The ANT-25, first Russian plane to fly from Moscow to the United States. *Below:* The crew, right to left: G. Baudukov, V. Chkalov, and A. Belekov. At left is A. N. Tupolev, under whose supervision the plane was built




Courtesy of *The New York Times*

Route of the first Russian trans-Polar flight

horsepower and weighs 1430 pounds, which is relatively light for a water-cooled engine. It will be noted that the aspect ratio (wing-spread to chord) of the wings is very large. This was necessary to secure efficiency in long-distance flying, but also introduced structural difficulties, since excessive wing-spread means undue weight of wings. One reason why this difficulty was solved was because the fuel tanks were each 21 feet long and placed in the wings, so that the weight of fuel relieved somewhat the upward lift on the wings. Also, the fuel tanks were made an integral part of the wing structure—a procedure which American designers might well imitate on occasion. To safeguard against forced landings over water, air-tight compartments were provided in the wings, so that ample flotation was provided.

All our congratulations to the constructors of the plane and engine and to the pilots of the flight.—*A. K.*

At the time of going to press, a second Russian plane has just landed at San Jacinto, California after successfully flying over the Pole. This flight, in a plane similar to the one described above, set a new distance record of 6262 miles.—*Ed.*

## Super-Terminal Airports

The Bureau of Air Commerce is re-classifying airports of the United States. As airplanes become larger and the wing loadings heavier, the length of run for take-off also becomes longer and so does the landing run. Moreover, it is not sufficient to have just the right length of runway; adverse weather conditions may necessitate landing at far higher speeds than normal, with a correspondingly longer run. Also, the take-off is not safely completed when the wheels have merely left the ground; the subsequent climb to clear surrounding obstacles must be taken into consideration. As a matter of fact, no one is quite certain what the exact requirements of an airport should be. Investigations to be made shortly by motion picture studies of take-off and landing will be very helpful in this regard. the Bureau of Air Commerce has promulgated the following classifications:

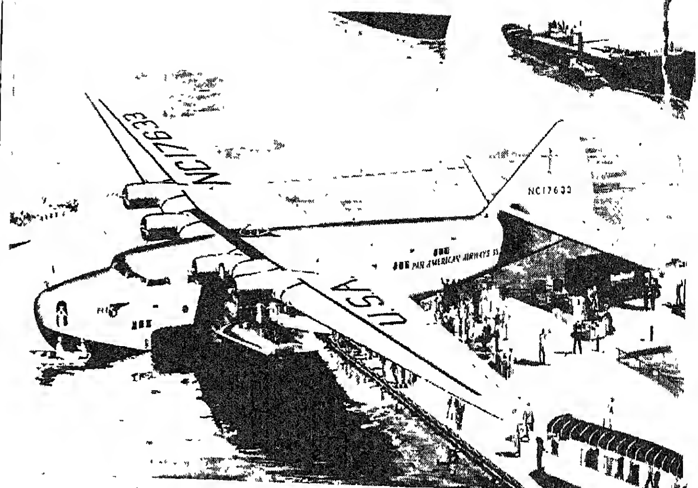
1. Super-terminals, with minimum runways of 4500 feet.
2. Terminals, with minimum runways of 3500 feet.
3. Limited terminals, with minimum runways of 2500 feet.
4. Airports with fuel, housing and servicing facilities.
5. Landing fields, which include emergency field, and so on.

Some of the best-known airports in the United States will not be able to meet the highest of these requirements and Newark, Chicago, Washington, Seattle, Detroit, Kansas City, and Portland, Oregon, will suffer tremendous loss of prestige thereby. Floyd Bennett in New York City will, on the other hand, meet all the requirements and its position relative to the Newark airport will be greatly strengthened.

Of course, there is a fine point in designing an airport; it must have runways long enough to be safe, but excessive length means a heavy financial burden. The difficulty is to strike the happy mean.—*A. K.*

## Conquering the Atlantic by Air

It is already a commonplace that a regular flying boat service is available between New York and the Bermudas, with Pan American and Imperial Airways happily co-operating and passengers commenting on the excellent meals served during flight. It is significant of the meticulous care exercised by these great operating companies that prior to extending the New York-Bermuda service farther across the Atlantic, they are going to make careful and numerous survey flights, with airlines charted and weather and radio services carefully checked and coördinated. Of course, the credit for the ultimate conquest of the Atlantic by air will be shared equally with the aircraft constructors and the engine builders, and the first information released on the giant Boeing *Clippers* for this work is of great promise. The Boeing Model 314 flying boat is to be equipped with four 1500




An artist's drawing of the Boeing transatlantic *Clipper*

Cyclones, probably the most powerful air-cooled engines in the world. Six in all of these giants are on order for Pan American Airways. Each of the planes will weigh more than 82,000 pounds gross and will have a wing spread of 152 feet, an overall length of 109 feet, and an overall height of 28 feet.

As can be seen from the artist's conception of the Boeing *Clipper*, the latest ideas in aerodynamics have been embodied in the design. The cantilever wings are no longer a novelty, but the manner in which the engine nacelles blend into the wing with a minimum of disturbance is particularly neat, and the lines of the hull are beautiful to the aerodynamic eye. There has been a good deal of argument in the past whether wing-tip floats (as in the Sikorsky Clippers) or sponsons—short sea-wings—(as in the Glenn Martin designs) are superior for all-around service. Since the Boeing 314 is to have sponsons, it may be taken for granted that sea-wings have won the argument—probably because they provide better taxying properties, help a little on take-off, and give less over-all aerodynamic drag. Careful inspection of the drawing will indicate that each of the control surfaces—rudder, elevator, and ailerons—is provided with *two* auxiliary trimmers or tabs. This used to be Boeing practice on the rudder only, and this is the first time the use of two tabs has been extended to the other control surfaces. One tab is used to give trim—that is, to give the control surface a required, steady position for cruising flight; the other tab helps in balancing the controls and reducing pilot effort.

Aside from the basic design of these newest *Clippers*, there are many features of interest. The Boeing 314 will be able to carry 72 passengers on day-time flights, with a crew of eight. At night, they will provide upper and lower berths for 40 passengers. Capacity for airmail and freight will be 5000 pounds. Speed will be approximately 200 miles an hour, with cruising range of 5000 miles. About 15 tons (5000 gallons) of gasoline will be carried in wings and sponsons; it is another advantage of the sponsons that they provide additional space for fuel. There will be two full decks—an upper deck for flight crew and cargo and a main lower deck with luxurious passenger accommodations. Finally, there will be companionways (often predicted and only now realized) affording

to the engines during flight. At the forward end of the upper deck will be located the "flight-bridge" with posts for the master and five other flight-officers. Behind the control rooms within the wings will be the main cargo compartments, with sleeping and living quarters for the crew directly behind them. The nose of the hull will provide additional cargo space and a compartment for the mooring apparatus.

A circular stairway will connect the upper and lower decks. The main deck, besides passenger cabins, will contain a dining and lounge salon in the center section, a galley forward, lavatories and dressing rooms for men at the forward end and for women in the after section. We may take complete sound-proofing, heating, ventilation, lighting, and so on, for granted.—*A. K.*

## Yankee Ingenuity and the Airship

SINCE everyone else seems to have philosophized on the *Hindenburg* disaster and guessed at the cause of the accident, we have felt it wiser to refrain from similar efforts here. But the thoughts of a correspondent, E. Burke Wilford, of the Pennsylvania Aircraft Syndicate, should be placed on the record. "Why should American airship construction follow German practice so slavishly?" asks Mr. Wilford. "Yankee ingenuity should carry forward the German rigid airship in the same manner that Glenn Martin and Sikorsky have developed the flying boat far beyond the Dornier *DO.X*. Originality and experimental work by American engineers could increase propulsive and structural efficiency so much as to offset the decrease in lifting power due to changing from hydrogen to helium. Why adhere to fabric cover when our metal-clad *ZMC-2* has proved out so well in extended service? Bow elevators, already used in the submarine, would have prevented the crash of the *Akron*, and higher factors of safety the wreck of the *Macon*." Our correspondent is perfectly right. If and when we resume airship construction, it may be well to consider a parting with mere tradition.—*A. K.*

## Thoughts on Pilots

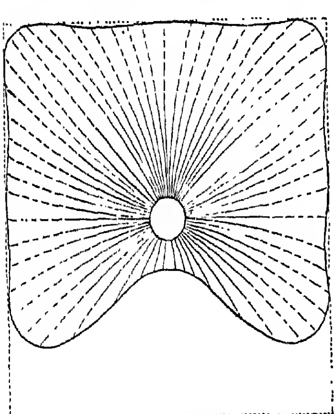
WHEN Major R. W. Schroeder speaks at an Air Line Safety Conference or on any similar occasion, we enjoy his racy

well-thought-out opinions on flying and fliers. Thus, on the question of co-pilots or second pilots: ". . . the pilot expects to be checked by another man. So we readily ask that we have the co-operation of the transport industry in providing a second pilot. We cannot expect him to have the judgment and experience of the first pilot, but he certainly should have a very good technical education and understanding of the construction and limitations of the power plant. Many of our old pilots are not of a mechanical turn of mind and generally they are not trained in engineering matters. They need the support of a second pilot who understands the general engineering condition of the aircraft and what a combination of temperature, pressures, and other items amounts to when summed up."

Apparently the new crop of young pilots is better in some respects than the old timers. "I am happy to report," says Major Schroeder, "that the operators have copilot material coming through that is very good first-class pilot material and I believe in many instances will surpass the present first-class pilot material. These new boys are not used to flying near the ground and do not know much about it and are happier when they are on instruments away from the ground, while the older boys hate to let loose of the ground. The new pilot recognizes that ships in deep air do not drag their bottoms any more than do ships in deep water at sea."

## A Versatile Lawn Spray

SPRAY patterns that are reminiscent of the broadcast patterns in the radio antenna story in another section of this issue are made by a new lawn sprinkler head. To outward appearance, this sprinkler is simi-

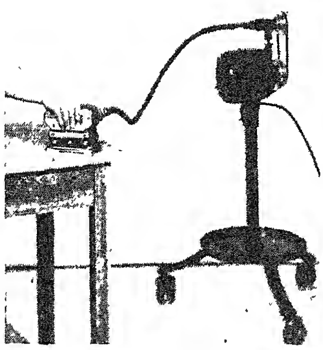


One of the many patterns possible with the new lawn spray described

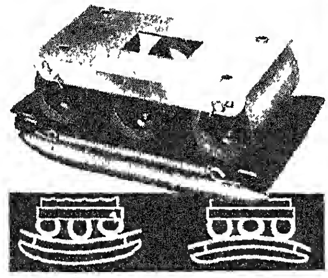
lar to many in general use, but it has adjustable nozzles which permit its use on sections of a lawn hitherto impossible to reach with a general spray because of the danger of wetting houses or pedestrians passing on the sidewalk. This spray can be adjusted to fit exactly a triangular section in the corner of a yard, a square section, an hour-glass section, and several other odd ones, to take care of varied limitations of different lawns.

## Motorized Sander

OSCILLATION through a stroke of ⅝ inch is imparted to a new sanding pad by power supplied through a flexible shaft



The complete motorized sander. *Below:* Flexible pad and its action



range from 1750 revolutions per minute to 2800 revolutions per minute to suit varying kinds of work. Three types of drive include motor mounting on a plate for bench work, motor suspension from overhead by means of bale-type handles and motor mounting on a pedestal as shown in the illustration. Operation is on 110 or 220 volts. The block to which the abrasive paper or cloth is attached is an assembly of flexible rollers of composition rubber and fabric with a flexible pad. The surface of the pad takes the shape of the surface being worked on—straight, convex or concave—as indicated in the lower of the two illustrations. From one to five sheets of abrasive can be attached at one loading, each being one third the size of a standard abrasive sheet.

The head is shaped to fit the hand and weighs 7½ pounds. The machine can be used in any position on surfaces of metal, wood, compositions, leather, or marble, for sanding, buffing, polishing. There is a water connection with a series of openings on each side of the block so the machine can be used for wet finishing. A special block is available for sanding with naptha or benzine.—*Industrial Equipment News.*

## Salt Prevents Ill Effects of Heat

A SERIOUS problem to many of the important industries of the country is the effect of extreme heat on employees. In mills and factories where of necessity high temperatures exist, the problem of heat cramps and heat prostration is especially acute. Cramps and prostration, however, are frequently met with in the hot months of summer where workers are unprotected from the direct rays of the sun, and, for that matter, even in mills where the temperature is lower than that of the outside air.

The use of salt as a remedy and preventive measure in such cases is several decades old, but only recently has its effectiveness been scientifically proved by successive

investigations of the value of salt as a heat prostration preventive was made by the Fatigue Laboratory of Harvard University, conducting experiments both at home and in the field. More than five years were spent in gathering data on the physiological and pathological effects of high temperature on workmen.

Dr. Arlie Bock, who is connected with the Harvard Fatigue Laboratory, suggests that a worker, working eight hours a day under extreme heat, should use plenty of table salt with his food and also should take five or six one-gram tablets of salt, enteric coated to prevent dissolution before the tablet leaves the stomach.

Salt tablets solve prostration problems. Since salt tablets have been made available several automobile plants have not had a single case of heat exhaustion. The tablets, each containing one teaspoonful of pure sodium chloride, are available at drinking fountains in many of the factories. They are swallowed whole, followed by one or more glasses of water. Holding that the principal cause of heat exhaustion is the loss of salt from the blood stream through profuse perspiration, Dr. E. R. Harris, physician at the Cadillac motor car plant, is urging shop workers to take from 10 to a dozen of the salt tablets daily.—Henry C. Marble, M.D., Surgical Director, American Mutual Liability Insurance Co.

## Controlling Growth of Weeds

SULFURIC acid spray as a method of controlling the growth of weeds in fields of grain is gaining ground in the United States. Tests covering several years and several thousand acres of grain fields in California have demonstrated the effectiveness of this method. During the present season more than 6000 acres are being kept free from weeds by spraying with solutions of sulfuric acid which kill weeds but do not injure the growing grain.

This is a meager beginning when in California alone there are more than half a million acres that could be benefited and when the vast grain fields of the midwest and the Pacific Northwest have not yet been touched. In France the treatment is already applied to more than 500,000 acres and its use is growing in England and on the Continent. The California development includes testing new, more efficient types of sprayers to cover larger areas more effectively.—*D. H. K.*

## Automatic Reception of Distress Signals

HITHERTO, the fate of the passengers and crew of a ship in distress has depended upon various uncertain circumstances. Oftentimes SOS signals did not bring the desired help, for the reason that when the call was sent out, the radio apparatus of some small steamer in the vicinity which carried only one operator did not get the message because the operator happened not to be on duty.

The German radio industry has recently developed an instrument for ships, which, when a certain pre-arranged alarm signal is received immediately preceding the SOS call, causes a bell to ring and a red light to glow. The alarm can immediately be disconnected when it has served its purpose. The instrument functions automatically, and requires little attention except occasional replacement of tubes. After having been thoroughly tested by the Reich Post-Office Department experts, this instrument has been installed on ships as a further means of safe-guarding life on the high seas.

### LAKE MEAD

THE enormous man-made reservoir behind Boulder Dam known as Lake Mead stored 13,582,000 acre-feet of water on June 1 of this year as compared with 7,076,000 acre-feet at the end of May 1936. Next to this lake, the largest reservoir in the United States is the Minidoka project in Idaho with 2,484,820 acre-feet storage.

## Signal Honor for Professor Russell

FROM *Nature*, published in London and regarded everywhere in the scientific world as the leading journal of science for the professional, we quote an appreciation of Professor Henry Norris Russell who, since 1900, has written a monthly astronomical article for Scientific American and for years has been its astronomical editor. *Nature's* comments on Professor Russell appear on the occasion of his election as a foreign member of the famous old Royal Society, an honor conferred only on a very few foreign scientists. The Royal Society is composed of the pick of Great Britain's scientists:

"Prof. H. N. Russell, professor of astronomy at Princeton University, U.S.A., is one of the best-known American astronomers. He first became prominent through his theory of stellar evolution, according to which a star, contracting continuously throughout its history, passed successively through a 'giant' stage of rising, and a 'dwarf' state of falling, surface temperature. This theory, regarded somewhat skeptically at first, gained general acceptance through the discovery, by means of Adams' and Kohlschutter's spectroscopic method for determining absolute magnitudes, of the reality of the distinction between giant and dwarf stars. The development of the theory of stellar constitution called for some amendment of the original postulates of Russell's theory, and it is characteristic of him that he made no attempt to preserve ideas based on insufficient data, but became a leader in the reformulation which was seen to be necessary. He was among the earliest to realize the importance of Saha's theory of ionization in stellar atmospheres, and took a leading part in working out its implications, always with a keen appreciation of the limitations placed on theoretical possibilities by difficulties inherent in methods of observation. The development of laboratory spectroscopy attracted him strongly, and with the collaboration of Prof. F. A. Saunders he obtained the first evidence of the co-operation of extra-nuclear electrons in producing line spectra: 'Russell-Saunders coupling' is now a well-established, and the most frequently recurring, type of such co-operation. More recently he has made im-

complex spectra corresponding to various stages of ionization—particularly those of metals prominent in celestial spectra.

"Prof. Russell's work is marked throughout by a breadth of interest and a clearness of apprehension of essentials which place him among the greatest men of science of the time. There is scarcely a branch of astronomy (with the possible exception of problems peculiar to the extra-galactic nebulæ) which has not attracted his attention and become elucidated thereby. He has recently advanced some very suggestive ideas relating to the origin of the solar system, and his text-book on astronomy, written in association with his colleagues, Profs. R. S. Dugan and J. Q. Stewart, is unique in its kind. He travels freely among the American observatories, and has for many years been regarded as a kind of unofficial ambassador-at-large, co-ordinating work of various types and often taking an active part in the solution of the problems encountered. His vivid personality is one of the most conspicuous and characteristic features of astronomical conferences, and the well-deserved honor now accorded him of foreign membership of the Royal Society will give universal satisfaction."

What *Nature* says in the next to the last sentence of the above quotation is often heard orally in American astronomical circles: Professor Russell's advice is sought by astronomers in many other observatories than his own at Princeton, and many speak of him as the dean of the profession in America where there are in all about 500 astronomers. (The above has been inserted without his knowledge.—*The Editor.*)

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**ICE CREAM**

**ICE cream was first produced commercially in 1851 in Baltimore. By 1900, according to *Food Industries*, annual consumption had reached 25 million gallons, and now it is 200 million.**

## Plastic Pistols

PHENOLIC resins are used to make the gun from which blank smoke cartridges are fired as an alarm when a bag of valuables is stolen from a messenger. This device, called "Tracelarm," described in this department in April, depends for its effectiveness on the fact that a light, strong gun for the delayed shooting of the alarm cartridges can be made of plastic materials which are not corroded or injured over a long period of time. This fact makes it unnecessary to grease or clean the shooting mechanism and keeps it always ready for action.—*D. H. K.*

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## Hay Fever Aided By Air Conditioning

VICTIMS of hay fever and other respiratory affections are assured of a "high degree of benefit" from air conditioning today, as a result of a series of pollen tests by Professor F. H. Hodgson, Department of Allergy botanist at Roosevelt Hospital.

Using an air-conditioning unit provided by Carrier Corporation, Professor Hodgson air was heavily saturated with dust and pollen. The unit was a summer portable room cooler without special attachments.

Actual results in one of the main tests in a "room to be used by an allergic patient," Professor Hodgson said, showed the pollen count reduced, in 10½ hours, from 1050 to two per square centimeter.

Summarizing the results of his various tests, the Professor reported:

"From the many experiments described, it would seem that the efficiency of the air-conditioning device is sufficiently good to assure a high degree of benefit to a patient suffering from exposure to air containing irritants, especially house dust and natural pollens."

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## Another Household Menace

IT is conceded that bathtubs are dangerous, that thousands of people are badly injured by falling in them annually, and that nothing much can be done about it. Amazing to many people will come the news that there is another very dangerous household fixture, a tiny one which could easily and cheaply be replaced by one absolutely safe, and yet one to which little attention has been paid. This is the porcelain handle on many lavatory and kitchen sink faucets. It seems harmless, but isn't.

Recently we read a doctor's warning against this instrument. He stated that he had treated quite a number of cases of bad hand cuts due to breakage of such porcelain faucet stems in normal usage. Often, it appears, the porcelain shell breaks off the inside metal stem under pressure of the hand alone, and the hand is gashed on the jagged, razor-sharp edges. If this one doctor can report a number of cases, how many can thousands of other doctors report, and what would be the total, in thousands annually, of such injuries? And how many cases of blood poisoning result?

The importance of this came to us when, recently, a member of our editorial staff suffered a cut on the thumb from one of the rotating porcelain handles which broke apart in his hand. A small artery was cut and it was necessary for a surgeon to connect this, remove part of a severed tendon, and take five stitches in the cut. Not quite so harmless, eh?

Strange it is that, with plastics available that can be colored and molded to simulate porcelain or be given almost any hue, the fixture manufacturers haven't long since eliminated this dangerous, glass-surfaced weapon! Perhaps they just haven't gotten around to it or people don't know enough of the danger to demand a harmless fixture. We urge that steps be taken at once to correct this fault, and, in the meantime, warn everyone to use that handle delicately. Don't force it as though it were a spillway gate on a dam; it's only a little gate for a trickle of water.—*The Editor.*

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## Versatile Detergent

SODIUM metasilicate, modern crystalline edition of the familiar water glass, is finding important uses as a cleaning agent. It has the property of helping to disperse particles of dirt in water to a remarkable degree. In addition to its value in the ordi-

clothing and utensils of the food industry, its unique properties are useful for a wide variety of different purposes. In concentrations of only 0.1 percent it makes the mud from drilling oil wells thin enough to pump. Dehairing hog carcasses is made easier if sodium metasilicate is added to the scalding water. Automobile radiators are cleaned by a solution of one ounce in a gallon, which not only removes dirt but reduces rusting. The processing of olives and the removal of skins from peaches are made easier if it is added to the water used. Even the homely tripe, which is considered a delicacy by many, is made whiter and cleaner by washing in a sodium metasilicate solution. These uses are aside from its very important application in laundries and in the washing of bottles.—*D. H. K.*

## Astronomers Search Mars for Water—Find "No Evidence Whatever"

MARS continues to be a desert, defying astronomers' biggest telescopes and most delicate instruments to find any trace of water vapor on the rust-red surface of its middle part. So report Drs. Walter S. Adams and Theodore Dunham, Jr., of the Mount Wilson Observatory.

Last April, Mars was in an especially favorable position for observation. The astronomers turned the great 100-inch telescope on the planet, arming it with a nine-foot spectral grating to split the light reflected from its surface into the rainbow band of the spectrum.

Dark absorption lines appeared in the spectrum, part of them due to the "soaking up" of the planet's light by water vapor in the atmosphere of the earth. Particularly critical study was made to see if any of this light absorption took place in water vapor in the atmosphere of Mars itself, before the light left on its long trip earthward. But of this the astronomers reported they could find "no evidence whatever."

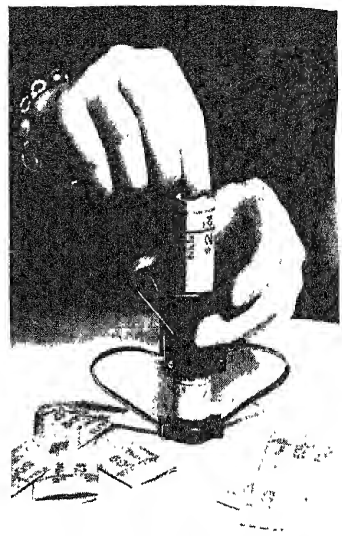
There remain still the polar caps of Mars—white patches on each end of the planet that grow and wane with changing seasons. But the position of Mars last April was such that, while good observations could be made on the middle of its disk, they could not be satisfactorily made on the polar regions. So that part of the puzzle will have to go unsolved for a while.—Copyright 1937 by *Science Service.*

**SIDE-WINDER**

**ONE variety of rattlesnake known as the "side-winder" rolls over the sandy terrain in which it lives in such a way that its direction of travel is almost at right angles to the direction in which it faces.**

## Coin Wrapping Simplified

THAT necessity is the mother of invention has once again been proved by Albert Wagner of Chicago. He has worked in bank departments for many years and recently was assigned the tedious job of



Stacking and wrapping coins is made easy with this simple device

decided that his assignment would be much simplified if he could design an efficient coin wrapping device.

The result is Packoin, a contrivance which makes it easy to put coins into wrappers much faster than by other methods. Wrappers can be filled as fast as the coins can be pulled off the edge of a counter into the Packoin funnel, which is sturdily constructed of Bakelite molded. The bottom piece is also made of the same material and serves as a base on which to rest the end of the round coin wrapper.

## Non-Corrosive Refrigerant

SULFUR dioxide, widely used in refrigerating machines, is a vigorous corrosive agent if even traces of moisture get into the system. A recent patent suggests adding an aldehyde (formaldehyde)—which boils at about the same pressure and temperature as sulfur dioxide—to this refrigerant in charging a refrigerating machine. This addition is stated to inhibit corrosion of metal parts even if moisture should enter the system.—*D. H. K.*

## Molded Contact Lenses

THE perfection of molded glass contact lenses, a great forward stride in the development of these invisible substitutes for spectacles, long awaited by the optical profession, was given public announcement recently by Carl Zeiss, Inc., after two years of co-operative work between their research laboratories in Jena and leading oculists in America.

This newest development in contact lenses follows widespread public and professional interest in these invisible aids to vision which are already worn by over 4000 people in this country. [See Scientific American, November, 1936.—*Ed.*]

Molded glass contact lenses are prescribed by oculists for patients whose irregularities of eyeball need for perfect fit a contact lens of equally irregular shape.

For this small minority of difficult cases, the general opinion of the optical profes-

contact lenses, now made with the same accuracy and precision as the ground type in common use, gives reasonable assurance that any eye may be fitted so as to ensure perfect comfort.

The new molded glass contact lenses in appearance are the same tiny, thin, transparent shells now in general use, covering just the iris and pupil and a tiny portion of the white of the eye.

In addition to bringing contact lens making to a hitherto unattainable degree of refinement, Zeiss has worked closely with those oculists in the United States who have been experimenting with the other portion of the work; that is, the making of the mold of the patient's eye.

Oculists in America use various materials for making molds. One method is to make a mold of the patient's eye with a mixture of Negocoll and water. When the mold is set, two plaster casts are made from it, one to go to Zeiss for making the glass contact lens, and one to be kept by the oculist for checking and record. Zeiss forms the lens against the cast, thereafter grinding in the corrections for vision in the center part which rests in front of the pupil.

## Vitamins and Gout

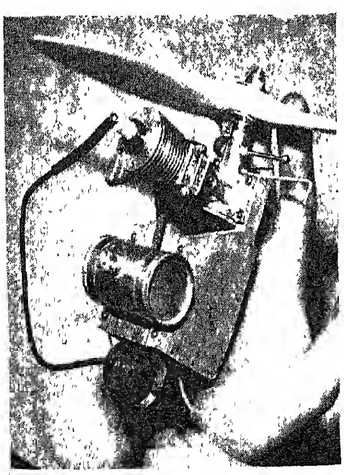
A VITAMIN discovery that sheds new light on gout and may prove a remedy for the ailment was reported by Dr. Martin G. Vorhaus of New York before a recent meeting of the American Medical Association.

Cases of this disease were improved by doses of vitamin $B_1$, Dr. Vorhaus has found. Pain and swelling disappear; what is even more striking, X-ray pictures of the affected joints show that new bone tissue is apparently formed.

This is the first time that anyone has ever discovered any effect of vitamin $B_1$ on bones, Dr. Vorhaus pointed out. Hitherto this vitamin was known only to affect nerves and the utilization of sugar. The discovery of its effect on bones is so new that Dr. Vorhaus and his associates have not yet decided exactly what is the relation between the vitamin and bones.—*Science Service.*

## Tiny Gasoline Motors in Mass Production

THE possibility of using small, highly efficient model airplanes as anti-aircraft targets is being given serious consideration by United States Army tacticians. Little ships, powered with tiny, one-fifth horsepower engines like that shown in one of our illustrations, may be adapted to such a use. They could be flown, according to plans under consideration, at 4000 feet, effectively simulating the flight of and presenting the same target as a bomber at 20,000 feet. These tiny engines burn a mixture of gasoline and oil, are two-cycle—as are outboard motors—and have the same rotary valve action as outboards. Triumphs in mechanical perfection, they are built in mass production at Glendale, California.



This small but efficient engine uses

## Electric Fret-Saws

IN compliance with the oft-expressed wish of many amateur wood workers for a small handy fret-saw worked by electricity, A. E. G. Company of Berlin has developed and put out an interesting little saw that has no electric motor, yet is electrically operated. It consists of an alternating current magnet and a suspended steel membrane, called the "anchor." The saw-blade is attached to the lower end of this anchor, while its upper end is held in an elastic steel hoop. When the current passes through the magnet, the steel membrane vibrates, carrying with it the saw-blade, which then moves back and forth 6000 times per minute. With this high speed, the sawing process is accelerated, while the strain on the saw is so slight that it shows no signs of wear for a considerable time.

## Stalking Odd Fish New Austral Sport

VISITORS to Cairns, in Queensland, Australia, have evolved a new sport—stalking the shy mud-skipper, which holds the distinction of being the world's most amazing fish in that it not only swims, but walks and leaps as well, and breathes through its tail.

Scientists know this unique creature as Periopthalmus. Queensland is the only place in Australia where it is found. With a stroke of its tail, the mud-skipper may skip over a yard of ooze. Shorter skips are made with the aid of its pectoral fins which are modified to be used as feet and even as hands in climbing up the oyster-encrusted mangrove roots, on which it likes to bask in the tropical sunshine of Queensland.

The mud-skipper's "golliwog" eyes earned the creature its scientific name. They are periscopic organs, each at the end of a protuberance and can be revolved in any direction, which is one reason the mud-skipper is so elusive. The creature's nest is a round pool, about twice the size of a dinner plate and with walls only a few inches high. In addition to its regular gills, its tail functions as a secondary organ of respiration, and scientists claim the mud-skipper might "drown" if kept in water too long.

## Get Elderly Patients Out of Bed

ELDERLY persons who become sick must be gotten out of bed and back on their feet as rapidly as possible, in order to stall off death, is the opinion of Dr. Louis B. Laplace and J. T. Nicholson of Philadelphia.

sons over 60 years, they found. The reason is that remaining inactive and prone for long periods allows the blood to accumulate in the small veins and arteries. The total volume of blood is thus reduced and its circulation is further impeded by the hardening of the blood vessels that occurs in old age.

The blood therefore remains in the capillaries until it is forced out by contractions of the muscles, but a person confined to bed moves his muscles so little that the blood does not circulate enough. As a result, tissues degenerate, ulcers form, and the body is slowly poisoned by absorption of the products from the degenerated tissues. The patient sinks into stupor and the final invasion of the bacteria into the lungs causes the fatal pneumonia.

The way to prevent this is to order elderly patients out of bed as soon as possible and, while they must remain in bed, to give them massage, exercise in bed, deep breathing, and frequent shifts of position.—*Science Service.*

**WIRE**

**IF joined together to make one long piece, the 79,373,000 miles of wire in the Bell Telephone System would reach from the earth to the moon and back more than 160 times.**

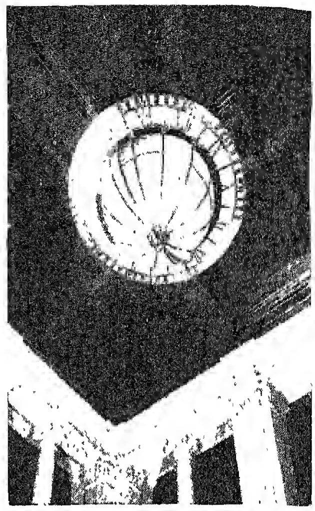
## Reducing Wood Swelling and Shrinkage

CHANGES in dimensions of wood pieces, particularly those used in parquet floors and mosaics, frequently destroy their usefulness and often account for the ghastly squeaks in floors and wooden structures of various kinds. These changes of size are caused principally by the tendency of wood to absorb or lose moisture with changes in the relative humidity of its environment. The processes of swelling and shrinking follow the grain of wood so that shape as well as size changes. Shape changes depend on the way the piece existed in the original log and result in serious distortion of most cuts.

Researches carried out at the Forest Products Laboratory have shown that the introduction of sugar solutions, particularly solutions of invert sugar obtained by treating cane sugar with acids, materially reduces the tendency of the wood to change dimensions. The treatment consists in soaking the wood in sugar solution under alternate pressure and vacuum and subsequent drying in air. Although not entirely satisfactory on account of a slight tendency of the surface to become sticky in very damp weather, this treatment has advantages over others where wood is used for framing and other concealed members in a structure.—*D. H. K.*

## Hanging Globe Electric Clock

REMARKABLE beauty and individuality in timepieces are illustrated by a unique terrestrial globe clock hanging in the foyer of the Christian Science Monitor Building in Boston.



The suspended globe is a clock

cate the hours by large Roman numerals and minutes by the smaller Arabic numerals around the edge. The operation of this clock is controlled by a Telechron motor, as is also a twin celestial globe at the other end of the foyer which gives the day of the month.

## Lubricating Peas

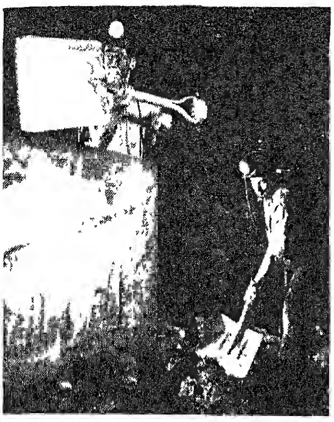
TO avoid breaking dry peas in some of the new seed planting machines, it has been found that 1½ ounces of powdered graphite added to each bushel of seed so lubricates their flow through the machine that damage is prevented.—*D. H. K.*

## Gas Through Metal

THE diffusion of gas through a piece of solid metal, so slowly that only one cubic inch of the gas passes through in a hundred thousand years, can be measured, Dr. Francis J. Norton of the General Electric Research Laboratory announced at the Chapel Hill, North Carolina, meeting of the American Chemical Society. The method of measurement introduces a new application for the all-metal vacuum tube, born in the same laboratory within the past few years and seen so commonly today in radio receiving sets.

Ordinarily it is considered that a metal container is gas-tight, provided its seams are tight. Hydrogen, the lightest gas, however, slowly escapes through metal, even of appreciable thickness. In his paper, Dr. Norton pointed out that, in high-pressure steam boilers, at a temperature of about 575 degrees, Fahrenheit, water and iron react to produce iron oxide and hydrogen. The iron oxide forms black scale on the tubes of the boiler; some of the hydrogen escapes as gas within the tubes, some combines with oxygen dissolved in the water, and the rest diffuses through the steel. The reaction occurs even at room temperature, but is greatly speeded up as the pressure and temperature are increased.

A detector-amplifier-triode metal vacuum tube was used by Dr. Norton for observing the hydrogen flow. The metal vacuum tube ordinarily has a coating of protective paint, and this was sand-blasted off for most of the experiments. The tube shell was then dipped into water at different temperatures



Coal miners, moving from 15 to 25 tons of coal in a day, perform a lot of work on their shovels alone. If these implements can be made lighter, yet able to stand the gaff, the miners can conserve energy. Thus the aluminum shovels, shown in the illustration above, which weigh two pounds less than ordinary coal shovels made of sheet iron

grid current measured. The measurements showed that, at 78 degrees, Fahrenheit, hydrogen entered through the 30-mil steel shell at a rate of one tenth of a micron per hour, which is about one cubic inch of gas per thousand years. The gas which passed through the steel was analyzed and found to be pure hydrogen.

Addition of 0.1 percent of sodium chromate to the water, known to inhibit corrosion, was found to stop the penetration of hydrogen through the steel.

## A New Use for Dyes

THE French scientist, Georges Claude, whose many scientific achievements are well known, has discovered a method whereby trans-oceanic air travelers may have a better chance of being rescued than heretofore, if the airplane is forced down at sea. From a recent *Associated Press* dispatch from Paris, *The DuPont Magazine* quotes these details:

By releasing a quantity of fluorescein, a coal-tar dye of high tinctorial strength, at the place where the plane descends, the water in that vicinity is changed to a distinctive color that is easily visible to rescue parties at a long distance.

In experimental tests made in the rolling Mediterranean Sea, 22 pounds of fluorescein placed in the water colored an area nearly 300 yards square, and the marking remained from 12 to 15 hours and was visible at a distance of 10 miles, according to a report made to the Academy of Sciences.

Here is another practical use for a coal-tar dye to write down in the book of chemical contributions to the aviation industry—an interesting one, and if it proves some day to be the means of rescuing even a single life at sea, it will be important.

## Treat Ulcers by Continuous Drip of Milk Into Stomach

A CONTINUOUS feeding of milk, drop by drop, into the patient's stomach is the new method of treating stomach ulcers reported by Dr. Asher Winkelstein of New York.

Frequent feeding of small amounts of milk and cream has for years been part of the standard medical treatment of stomach ulcer. The milk, together with alternating doses of alkaline powders such as bicarbonate of soda, is given to neutralize the acid normally secreted by the stomach but which irritates the ulcer and prevents its healing.

Dr. Winkelstein's modification of this method into a constant feeding of milk, a drop at a time through a tube, is based on studies of stomach secretion, especially at night.

The importance in connection with stomach ulcers of nervous over-secretion of acid by the stomach was emphasized by Dr. Winkelstein.—*Science Service.*

# CURRENT BULLETIN BRIEFS

*(Bulletins listed as being obtainable through Scientific American can be supplied only by mail)*

Neoprene, a Remarkable Engineering Material, is the title of a well-written booklet that describes in rather complete detail the uses and possibilities of a synthetic rubber-like material that has grown in a few years to be an important factor in many industrial applications. This booklet shows the advantages which Neoprene holds over ordinary rubber in certain uses. Write for *Bulletin 937A, Scientific American, 24 West 40th Street, New York City.—3 cents.*

Engine Bearing Service Manual tells how to diagnose and correct automotive engine troubles caused by worn or cracked bearings. The pamphlet contains 32 pages, has numerous illustrations, and covers the entire subject in non-technical language. It discusses the various engine troubles caused wholly or in part by defective bearings, and describes related operations necessary to of automotive engine is covered, and the many types of bearings used are discussed. *Federal-Mogul Corporation, Detroit, Michigan.—Gratis.*

Accident Facts, 1937 Edition, is a 96-page booklet, including a comprehensive index, which gives accurate data on accidents during 1936, and comparisons with accidents in the same fields during earlier years. It covers all kinds of accidents including occupational, motor vehicle, railroad, aviation, and home. *National Safety Council, 20 N. Wacker Drive, Chicago, Ill.—50 cents.*

Greater Lighting Efficiency is an illustrated booklet which gives facts and figures about the newly improved 33-inch and 50-inch horizontal Cooper Hewitt lamps, as redesigned for better industrial lighting. These lamps now feature instantaneous starting, greater operating stability, and in-

given for computing the proper spacing of these lamps to obtain any given illumination level. Write for *Bulletin No. 520, General Electric Vapor Lamp Company, Hoboken, New Jersey.—Gratis.*

CORROSION RESISTANT STEELS IN SULPHITE PULPING, by F. L. LaQue, is a reprint from *The Paper Mill and Wood Pulp News*, dealing with the toll of sulphite corrosion in paper mill equipment. This type of corrosion has been requiring repeated replacement of machinery in the industry ever since the inception of the sulphite process. Only within comparatively recent years have steps been taken to minimize this loss which is reflected in the increased cost of paper production. Corrosion of materials formerly used in cooking equipment and now being replaced by stainless steel was estimated in 1930 to cost all the sulphite mills in the United States and Canada an average of 10,000 dollars per year per mill. *The International Nickel Company, Inc., 67 Wall Street, New York City.—Gratis.*

ESSENTIAL EXPERIMENTS IN GENERAL SCIENCE, by Herschel N. Scott, published in two parts, affords an efficient outline of actual demonstrations of the broad principles of science as a background for the high school course in General Science. Part One is divided into nine units, usually taught during the first semester, and Part Two into seven units for the second semester. The units are divided into individual experiments which are adequately described. *Beckley-Cardy Company, Chicago, Illinois.—50 cents per part.*

HAYNES STELLITE J-METAL CUTTING TOOLS is a new 52-page illustrated booklet of interest to every user of machine tools. It contains complete detailed information on how to achieve maximum results in machining cast iron, malleable iron, and most steels. Included are such important topics as methods of obtaining longer tool life, proper tool grinding, and recommended speeds for machining a variety of materials. An extensive table of grinding wheels enables the user to select quickly the proper wheel for any specific tool grinding operation. *Write for Bulletin 937B, Scientific American, 24 West 40th Street, New York City.—3 cents.*

HOW TO RUN A LATHE, a well-known machinists' manual, has recently appeared in its 33rd edition. In 160 pages, profusely illustrated, is presented the latest and most authoritative information on the fundamentals of modern lathe practice. The book is widely used as a handy reference by all engaged in metal working operations, as it gives instructions on every phase of lathe work in easily understandable language. It also includes a vast amount of useful shop information, such as reference tables and formulas, tables of cutting speeds of metals, gear cutting, shop hints and short cuts, and so on. *South Bend Lathe Works, South Bend, Indiana.—25 cents.*

RADIO SERVICING SHORT-CUTS, by M. N. Beitman, is a really practical handbook for the radio service man. The information given includes many money-making ideas as well as service hints applicable to all sets. It states that four out of ten radio jobs can be repaired with a screw driver, pliers, ment. By actual test nine out of ten jobs need only the addition of the simplest meters. The faults of many radio sets can be found by a visual inspection and this booklet tells how. Write for *Bulletin 937C to Scientific American, 24 West 40th Street, New York City.—50 cents.*

MORE GOODS FOR MORE PEOPLE is an accurate analysis of the reductions in cost of materials and goods made possible by modern production methods. It gives startling figures which show what dozens of products would cost if made by methods in use 20 years ago. *National Machine Tool Builders' Association, 10525 Carnegie Avenue, Cleveland, Ohio.—Gratis.*

PICTORIAL OF WELDING PROGRESS is a photographic review of industrial uses for arc welding. It is presented in the form of an eight-page rotogravure section, and gives succinct information in its well-written captions. *The Lincoln Electric Company, Cleveland, Ohio.—Gratis.*

INDUSTRY AT WORK gives a complete picture of modern packaging as it applies to modern industries. Lavishly illustrated with photographs that practically tell their own stories and show particularly those packaging operations which are controlled by weight. *Write for Bulletin 937D, Scientific American, 24 West 40th Street, New York City.—3 cents.*

CAPITAL GOODS AND AMERICAN PROGRESS is a simple discussion of the causes of sharp fluctuations in capital goods production, and the relation of the capital goods industries to employment and the American standard of living. A series of carefully worked out charts illustrate the text. *Machinery and Allied Products Institute, 221 North La Salle Street, Chicago, Illinois.—Gratis.*

PHOTO DATA AND EXPOSURE RECORD contains ten pages of data and tables presented in compact form, together with helpful suggestions for the amateur photographer, and a record section containing a new type of table which allows room for over 800 records of exposures. This pocket-size booklet may be obtained from your photographic dealer or directly from *Galleon Press, 381 Fourth Avenue, New York City.—25 cents.*

WELDING IN CONSTRUCTION WORK illustrates a great variety of applications of arc welding in the structural field, both in the erection of miscellaneous structures and in maintenance work on construction machinery. The bulletin contains 12 pages well illustrated. *Write for Bulletin 937E, Scientific American, 24 West 40th Street, New York City.—3 cents.*

WORLD CHEMICAL DEVELOPMENTS IN 1936 is a new review of the chemical industry of the world, covering developments in 40 countries. It discusses new processes, plant expansion, cartels, export bounties and other government assistance, and other significant phases of the industry. It deals with such products as plastics, solvents, paints, naval stores, industrial chemicals and chemical specialties, insecticides, dyes, and a host of others. *Superintendent of Documents, Washington, D. C.—30 cents (coin). (In*

# LEGAL HIGH-LIGHTS

## Patent, Trade Mark, and Related Legal Proceedings That May Have a Direct Effect on Your Business

By ORSON D. MUNN, Litt.B., LL.B., Sc.D.
New York Bar
Editor, Scientific American

### INVENTIVE ADAPTATION

THE adaptation of a device or method which has been used in one art to a new use in a non-analogous art may amount to invention.

In a note entitled "Futile Utility" appearing on this page in the June, 1937, issue of Scientific American, it was pointed out that ordinarily a new use for an old device does not amount to invention. This principle of law is usually applicable where a device is applied to a use which is inherent in, and naturally flows from, the nature and construction of the device even though the use was not appreciated at the time that the device was created. Where, however, a device is modified and adapted to a use in an entirely non-analogous field, the adaptation may amount to invention.

An example of the type of adaptation which may amount to invention is to be found in a recent case decided by the United States District Court for the District of Delaware involving several patents for a machine and method used in forming points for shirt collars. The Court found that prior to the invention of the patents in suit considerable difficulty was had in the formation of collar points due to the accumulation of surplus material at the points. Many unsuccessful attempts had been made to overcome this difficulty. The Court found that the patents in suit overcame the prior difficulties by means of a method and a machine which confined the edges of the collar at the points to the desired shape and then applied heat and pressure to the collar within the confined area.

At the trial it was contended that the confining of an area of material by means of a die and then applying heat and pressure to it in order to obtain an object of the desired shape was a common method of forming objects from plastic materials, and that the application of this treatment to textile materials was merely a new use for an old method and apparatus, and did not amount to invention. The Court disagreed with this contention, and found that the patentees had done more than merely find a new use for an old method and apparatus; they had adapted a method and apparatus known in one art to a new and non-analogous art. The Court pointed out that textile material such as used in forming collars did not flow when heated as in the case of plastic materials, and that it was necessary to change or modify the apparatus used in treating plastic materials in adapting it to the manufacture of shirt collars. It was finally concluded by the Court that the method and apparatus for forming points on shirt collars was a

the Court quoted the United States Supreme Court as follows:

"Indeed it often requires as acute a perception of the relation between cause and effect, and as much of peculiar intuitive genius which is a characteristic of great inventors to grasp the idea that a device used in one art may be made available in another as would be necessary to create the device *de novo*."

### PROTECTED PLANS

PLANS or diagrams for the construction of toy models have been held in a recent decision to be proper subject matter for copyright.

In its decision, the Court found that both parties to the suit were selling sets of parts which when assembled constituted crude models of the ship *Queen Mary*. The purchasers of the sets were furnished with instruction sheets containing plans or diagrams for teaching the assembling of the various parts. The plaintiff's plans or diagrams were copyrighted, and plaintiff contended that the defendant had copied them. The Court found that the plans or diagrams were proper subject matter for copyright, and awarded a temporary injunction restraining the defendant from selling plans infringing on the copyright, pending the trial of the case.

### STILL EXPANDING

IN a note entitled "Expanding Symbols," appearing on this page in the March, 1937, issue of Scientific American, we pointed out that trade marks are of growing importance in modern commerce.

The importance of a widely known and distinctive trade mark is further emphasized by a case recently decided by the New York State Supreme Court indicating that the courts attempt to protect such marks even against encroachments of a non-competing character. In that case the plaintiff was the owner of the well-known trade mark Philco for radio sets, storage batteries, and similar products, and the defendant was using the same trade mark in connection with the sale of razor blades. The plaintiff and defendant did not sell in competition with each other, as it can hardly be contended that razor blades compete with radio sets and storage batteries. In spite of that fact, the Court awarded a temporary injunction to the plaintiff restraining the defendant from using the trade mark Philco in connection with the sale of razor blades.

In disposing of the contention that the parties were not engaged in actual competition with each other, the Court stated:

"Courts generally have come to recognize that actual competition in a product is not essential to relief under the doctrine of unfair competition. Whatever may have been the ancient rule, it is now clearly established that the two products need not be competitive."

### FRAUDULENT COPYING

ORDINARILY the copying of a machine or article of manufacture cannot be restrained unless the copying constitutes patent infringement. However, there are certain instances where copying of a machine or article of manufacture may amount to unfair competition, and as such will be restrained. Thus where fraud or subterfuge is resorted to in making the copies, the copying will be restrained.

In a recent case in New York, a court restrained copying which it found to be fraudulent. In that case the plaintiff designed and built a monophone for use on ships, and a salesman using one of the machines made by the plaintiff, obtained an order for 46 monophones from a steamship company. Instead of returning the machine to the plaintiff and giving them the order, the salesman delivered the machine to a competing manufacturer and employed that company to copy the monophone and fill the order obtained from the steamship company. The court found that the circumstances as outlined above constituted fraud, and awarded damages to the plaintiff, and an injunction prohibiting further manufacture of the monophone by the competing manufacturer.

### DRUMHEAD

THE drum is one of the oldest musical instruments known. Even the most primitive of peoples employed the rhythmic beatings of the drum in connection with their savage rites. Because of its antiquity it would naturally be assumed that the drum had long ago been developed to a state of perfection. Accordingly, when a patentable improvement is made in a drum it is news.

A United States Circuit Court of Appeals has affirmed the decision of a District Court sustaining the validity of a patent on a drumhead. The patent is for a drumhead made of silk or similar fabric treated with a cellulose ester and a plasticizer.

In reaching its decision the Court found that prior to the teachings of the patent in suit, drumheads had been made of animal skins, particularly calf skin, and that they were affected by variations in temperature and humidity. Thus on a humid day the drumhead was loose while on a dry day it became taut. This of course was a disadvantage which required frequent adjustment of the drumhead. The Court then pointed out that the fabric drumhead invented by the patentee had overcome the difficulties and that it was unaffected by changes in temperature or humidity.

The Circuit Court of Appeals, in affirming the decision of the District Court, stated: "We agree with it (the District Court) that for the first time in the art the patentee's invention did away with the centuries-old use of animal skin drumheads and gave the musical art a drumhead of treated silk impervious to weather conditions and of sustained tonal quality."

# Books SELECTED BY THE EDITORS

FAMOUS AMERICAN MEN OF SCIENCE

*By J. G. Crowther*

ALMOST any good writer could compile the biographies of four outstanding American men of science, but these are no ordinary biographies. In addition to giving an account of the careers of Franklin, Henry, Gibbs, and Edison—probably the ablest four scientific men in our history—the author, a widely known expositor of science, has given interpretations of their lives in terms of historical background and social philosophy, and penetrative ones at that. Of the four men of science chosen, everybody has heard of two; well-read persons know of the third; but how many outside the realms of pure science have more than heard of Willard Gibbs? Yet a vote among pure scientists both here and in Europe would surely include Gibbs as one of our four greatest scientists, if not the greatest. The chapter on the rise of American inventiveness shows clear insight into American life, as does the whole book, whether in accuracy of description or in the interpretation of American history—social, industrial, and political. In this respect alone this work is a remarkable feat of writing.—$3.70 postpaid.—*A. G. I.*

THE NEW INTERNATIONAL YEAR BOOK (1936)

*By Frank H. Vizetelly, Litt.D., LL.D.*

FOR those who are familiar with past editions of this work no recommendation is necessary. It is perhaps the most complete survey of happenings in all fields of human endeavor that is available in this country. Listed alphabetically, the news of the whole past year is included in meaty, condensed form. Several bindings are available, of which that in cloth is $6.50 postpaid.—*F. D. M.*

NATURAL COLOR FILM

*By Clifford A. Nelson*

"WHAT it is and How to Use it," the subhead of this volume, ably covers the scope of the text. It is specifically confined to the use of "Kodachrome" and tells what to photograph, how to compose for best arrangement of colors, light conditions, and exposure, and the general technique of handling the film and camera. While the author [illegible] ture work, the information given will be of great value to the still photographer who desires to use Kodachrome. The text is non-technical to a degree, authoritative, and highly informative. Several charts assist in explaining certain phases of the work.—$1.65 postpaid.—*A. P. P.*

THE MOON WITH THE NAKED EYE AND FIELD GLASSES

*By C. N. Joyner, B. E.*

A 135-PAGE book containing eleven 5 by 7 inch half-tone photographs of the moon, each faced by a key chart of names of features and an informative chapter of description; also chapters of general interest, an index to lunar features, and in a pocket a 24-inch folding map of the moon's main naked-eye features. This book is for naked eye and field glass work.—$3.00 postpaid.—*A. G. I.*

THE NEW BETTER SPEECH

*By Andrew Thomas Weaver, Ph.D., Gladys Louise Borchers, Ph.D., and Charles Henry Woolbert, Ph.D.*

NERTS! Swell chance these profs have to put over a serious study of our lingo! The bozos who read the magazines made up of pix and newspapers ditto will just hand 'em a razzing for their efforts. But, seriously, if we are to believe the apologists for our slipshod speech—who claim that it is usage that makes our language—then there is no new, better speech. However, those who are seriously interested in improving their diction and their personalities—seriously interested—will find this volume a gold mine of information and inspiration. We actually found it stimulating reading. If you are a speaker, debater, writer, or just an everyday talker you, too, will read the more than 500 pages of this book with great interest.—$1.75 postpaid—*F. D. M.*

SAFELY THROUGH CHILDBIRTH

*By A. J. Rongy, M.D.*

AN illustrated guide for the expectant mother, by a well-known gynecologist, clearly explaining procreation, pre-natal care, labor, and post-natal care; also undesired abortion. Our [illegible] storehouses of scientific information, in addition to bearing much larger families than women do today—and often lost half of their babies if not themselves, due to thus leaving everything to the beneficent processes of nature.—$2.15 postpaid.—*A. G. I.*

THE MODEL

*By William Mortensen*

WHEN the amateur photographer attempts to take photographs in which models play an important part, he is likely to encounter difficulties in that his models assume strained, unnatural positions. Without some knowledge, either gleaned or inspired, it is virtually impossible to produce satisfactory photographs of models except by the mere chance exception which proves the rule. For those photographers who would like to know the difference between good and bad photographs of models, who perhaps may wish to use models in their own work, Mr. Mortensen has produced the present book. Dealing with the subject of posing in a realistic manner, with emphasis on the right and wrong methods, he has managed to put over his subject with a minimum of superfluous words and a maximum of excellent illustrations.—$2.15 postpaid.—*A. P. P.*

FREEHAND AND PERSPECTIVE DRAWING

*By Herbert E. Everett and William H. Lawrence*

ACCOMPLISHED artists often fail miserably when drawing perspective. For them, as well as for the student draftsman or artist, this volume is a complete technical treatise on the subject, starting with explanations of the perspective of the simplest forms and continuing through more complicated forms such as, for example, a many-gabled house, elaborate column capitals, and floral designs.—$1.65 postpaid.—*F. D. M.*

MODEL AERONAUTICS

THE third year-book of the above name is somewhat of a revelation to the reviewer. A flying model is frequently thought of as just something with which to amuse a boy. In reality, a flying model of the best type is a piece of skilled engineering, involving lightness of construction, skill in building

edge of the aerodynamics involved, so that the model not only makes the longest possible flight but also does not stall and dive too steeply to earth when the motor has finished its effort. The construction of a gas-driven model is a work of even greater complexity. The year book covers Theory, Aerodynamics, Propeller Design, such topics as whether a propeller should be free-wheeling or not, scale models, gas-models, and so on. We heartily recommend it to anyone who wishes to acquaint himself thoroughly with this delightful hobby. Even the well informed aeronautical engineer can learn something from its pages in regard to low-speed aerodynamics, and the behaviour of an aircraft when the motor suddenly stalls. —$1.15 postpaid.—*A. K.*

### ZERO TO EIGHTY

*By Akkad Pseudoman*

"BEING my lifetime doings, reflections, and inventions; also my journey around the moon"—the subtitle—means but little to the reader until he has learned that the author is Dr. E. F. Northrup, writing under the queer sounding pseudonym. At first glance, the book itself would seem to be just another Jules Verne attempt to incorporate certain basic scientific facts into a work of amazing fiction. Dr. Northrup's work, however, is much sounder than others of its general type from the standpoint of physics and dynamics and is well enough written to be entertaining fiction. To check his theories in regard to the flight to the moon, Dr. Northrup made a number of costly experiments in his laboratory and the result is that there is strong flavor of reality to his theoretical flight. As a result of his research he has developed—in theory—an electric gun the barrel of which is 170 miles long and would lie on the gentle slope of Mt. Popocatepetl in Mexico. This will prove intensely interesting to all followers of Jules Verne—those who delve into scientific fiction, both young and old—who are looking for new worlds to conquer.—$3.20 postpaid; Foreign $3.50.—*F. D. M.*

### BEYOND NORMAL COGNITION

*By John F. Thomas, Ph.D., with a foreword by Prof. William McDougall*

A DETAILED study of mediumistic utterances, with central emphasis on the question: "Are there instances of supernormal information?" Most of the 24 mediumistic records analyzed in it were "absent sittings"—that is, taken when the person who alone knew the facts was some thousands of miles distant. The book is concerned with so-called "mental" mediumship alone, thus excluding physical levitations and so on, and the entire procedure took place in the light. (This research represents an effort on the part of psychologists rather than parlor amateurs, and there was no trifling with mediums, no laying down of obstructing conditions to hamper science; there is also a welcome absence of certain other kinds of hocus-pocus, as the work was done at Duke University under university supervision.) Telepathy and clairvoyance hypotheses seem by these studies to be validated. This book is not meant to be easy running reading; it is a study.—$3.70 postpaid.—*A. G. I.*

### MAN IN A CHEMICAL WORLD

*By A. Cressy Morrison*

CALLED by the publishers the "Autobiography of an Industry," this book is just that. It is a straightforward presentation of the story of chemical advance in all fields of human endeavor and shows how this great branch of science has lifted man to his present high state of technical achievement. Reading it gives one an entirely new conception of present-day civilization for, without a doubt, we lean more today on chemistry than on perhaps any other single science. The long chapter entitled "All the Comforts of Home" is alone, to the layman, worth the price of the volume. A complete index makes this book valuable as a reference.—$3.15 postpaid.—*F. D. M.*

### DR. BETTERMAN'S DIARY

*Edited by Charles Elton Blanchard, M. D.*

THE homely diary of a humble and much beloved country general practitioner, extending from 1868 to 1910 and containing many sidelights and anecdotes on medicine and men—mainly men. Human, sincere, readable, hard to put down.—$3.15 postpaid.—*A. G. I.*

### MODERN WAR

*By Lieut.-Col. B. C. Dening, M.C., R.E., p.s.c.*

WHETHER you agree with Colonel Dening's premise that armies, not air forces, decide wars, you will find his discussion extremely stimulating. This controversy relative to the menace of aircraft in modern warfare will continue to rage, proponents of aircraft gaining the ascendancy at times while those who believe that aircraft do not present an unconquerable menace win a point now and then. Colonel Dening makes out a strong case for the latter, discussing the fallacy of the air menace, the military power of a nation, objectives in war, the tactical changes in instruments of war, and army organization. In his conclusion, he mentions that his aim has been to call attention to certain mistaken ideas and to indicate the factors that are likely to decide the next struggle—this next struggle seeming indeed to be the key-note of the volume.—Stiff paper binding, $3.00 postpaid.—*F. D. M.*

### COLLEGE PHYSICS

*By John A. Eldridge, Professor Physics, University of Iowa*

AS an offset to many or most of the physics textbooks that have appeared during the past decade or two, this one is not three fourths atomic physics, with the older physics badly neglected, but the reverse: most of its 616 pages are devoted to classical physics, and with emphasis on everyday things rather than detached theory. It is compact rather than wordy, and is not a "physics-made-easy" text (there being no such animal in this branch of science). It is recommended mainly as a review for those who have once studied physics and later let the joints become creaky.—$3.90 postpaid.—*A. G. I.*

### THE OUTLINE OF SCIENCE

*By J. Arthur Thomson*

ORIGINALLY published in four volumes, this monumental, popular work has now been bound into a single volume of over 1700 pages. The set sold for $18.00 but the single complete volume has been produced at a greatly decreased cost. See back cover advertisement.

### AIR CONDITIONING IN THE HOME

*By Elmer Torok, M. E.*

MORE and more the technical details of air conditioning begin to interest those not directly connected with the manufacture or installation of equipment. This volume is one of the first we have seen which is as useful for the home owner as for the engineer and architect. For the man who intends to install this modern equipment in his home now or in the near future, the facts concerning the fundamental principles of air conditioning, the various kinds of equipment and what each will do, and how the equipment is installed and operated, are all here. Included also are several house plans suggesting piping layouts, and examples of heat and cooling calculations. Much of the book is technical but there is enough of general knowledge to make it well worthwhile for laymen.—$3.20 postpaid.—*F. D. M.*

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## The SCIENTIFIC AMERICAN DIGEST




# SCIENTIFIC AMERICAN

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NINETY-THIRD YEAR • ORSON D. MUNN, Editor


## CONTENTS · OCTOBER · 1937

9-10-37



TECHNOLOGICAL advances that have been responsible for the vast improvement in turbine design and performances are fully discussed in the article "Mass Power" which starts on page 202 of this issue. To this work have been brought to bear many of the forces of science, including among the most prominent those of metallurgy and highly accurate machine work. Illustrative of the processes involved in turbine manufacture is our cover photograph, reproduced by courtesy of Westinghouse Electric and Manufacturing Company—a workman drilling a turbine condenser cover.


SCIENTIFIC AMERICAN, October, 1937, Vol. No. 157, No. 4, entered at the New York, N. Y. Post Office as second class matter June 28, 1879, under the act of March 3rd, 1879; additional entry at Greenwich, Conn. Published monthly by Munn & Company, Inc., 24 West 40th Street, New York City. Copyrighted 1937 by Munn & Company, Inc. Great Britain rights reserved. Subscription price $4.00 per year. Canada $4.50. Foreign $5.00. Manuscripts are submitted at the author's risk and cannot be returned unless accompanied by postage.

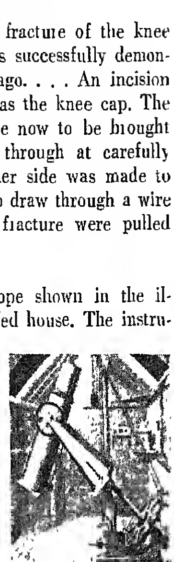
# 50 YEARS AGO IN . . .

## SCIENTIFIC AMERICAN

*(Condensed From Issues of October, 1887)*

SURGERY—"A new method of treating a fracture of the knee cap, 'wiring the patella,' as it is called, was successfully demonstrated at Bellevue Hospital a day or two ago. . . . An incision was made across what is familiarly known as the knee cap. The two sides of the fracture thus revealed were now to be brought together. A sort of crochet needle passed through at carefully sought and directly opposite points on either side was made to carry threads, and these in turn were used to draw through a wire by means of which the two sides of the fracture were pulled closely and firmly together."

HARVARD OBSERVATORY—"The telescope shown in the illustration is contained in a small gable-roofed house. The instrument is erected on a very solid foundation, one which had been used in observing the transit of Mercury in 1878. Attached to its base is a circular level of exceedingly great delicacy, by which it can, when necessary, be adjusted. . . . The gable roof is in two sections, being divided across its center, and is mounted on wheels running on tracks parallel to the ridge. When the instrument is in use, these two segments are pulled apart. . . . The mounting of the telescope is peculiar. A steel tube is carried by trunnions in the end of a large fork. Into this tube the brass tube containing the lenses is screwed. The polar axis is a prolongation of this fork."



HORN—"M. Zigang has devised a trumpet worked by electricity and designed to warn or signal vessels, trains, or tram cars. It consists of a trumpet tube and a sounding plate which is vibrated by the electric current passing through an electro-magnet having its poles close to a soft iron armature carried by the plate. A regulating screw contact, with a platinum point, rests against the iron armature and serves to interrupt the current of two Leclanche elements as the plate vibrates, thus keeping up the sound as long as desired."

MASS PRODUCTION—"A striking instance of the extent to which labor saving machinery is carried nowadays, says the *Industrial Journal*, is shown in the tin can industry. Everybody knows that tin cans are manufactured by machinery. One of the machines used in the process solders the longitudinal seams of the cans at the rate of fifty a minute, the cans rushing along in a continuous stream."

NIGHT FARMING—"Howard County farmers residing in the vicinity of the great Shrader gas well, near Kokomo, Indiana, go on record as harvesting the first wheat by natural gaslight."

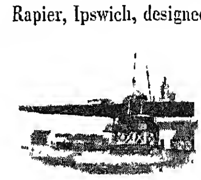
HOMING PIGEONS—"Steps have been taken in nearly all European countries to establish military communication by means of carrier pigeons in time of war. England, France, Germany, Belgium, and Italy have definitely organized military carrier pigeon services and some have subsidized the private training establishments, with the right to use the pigeons in war."

MODERN GUNS—"General S. V. Benet, Chief of Ordnance, U. S. A. . . . is quoted as saying: 'We have now twenty-five of the new steel guns ready, and twenty-five more will be ready in a few months. That will be sufficient to arm all our light batteries with breech-loading guns. The steel for these guns was supplied by the Midvale Foundry, of Philadelphia. All modern steel guns are of one of two systems—either the Krupp bolt system or the "interrupted screw" system, which seems to offer the greatest advantages. Like all good modern inventions, it is an American one.'"

PUMPS—"The Lawrence Machine Company, Lawrence, Mass., have been awarded the contract for one of the largest pumping plants ever planned in America. The plant is for the city of Montreal, and consists of four centrifugal pumps, each with a discharging opening of 24 inches diameter, and capable of handling 18,000 gallons of water per minute, and four similar pumps of 15 inches discharge opening, and a capacity of 7,000 gallons per minute."

MUSKRAT—"Near Nashua, N. H., recently a muskrat, in digging a hole in the bank of a canal, caused a leak, and eventually, a disastrous flood. The water swept through the woods, carrying trees and everything else movable with it into the Nashua River. The mills at once shut down, and 3,000 persons will be kept out of employment. . . . It will take three weeks to repair the damages caused by that one muskrat."

CRANE—"We illustrate a new all-around crane by Ransomes & Rapier, Ipswich, designed to lift a test load of 33 tons at a radius of 67 feet; the maximum radius which can be obtained with it in ordinary work being nearly 80 feet. The machine is self-propelling, being borne on a carriage which is mounted with 32 springs on 16 wheels, and has a gauge of 21 feet and sufficient height to allow a railway train to pass under it. The various motions of lifting the load, traveling, altering the radius, and turning are all performed by the steam engine."



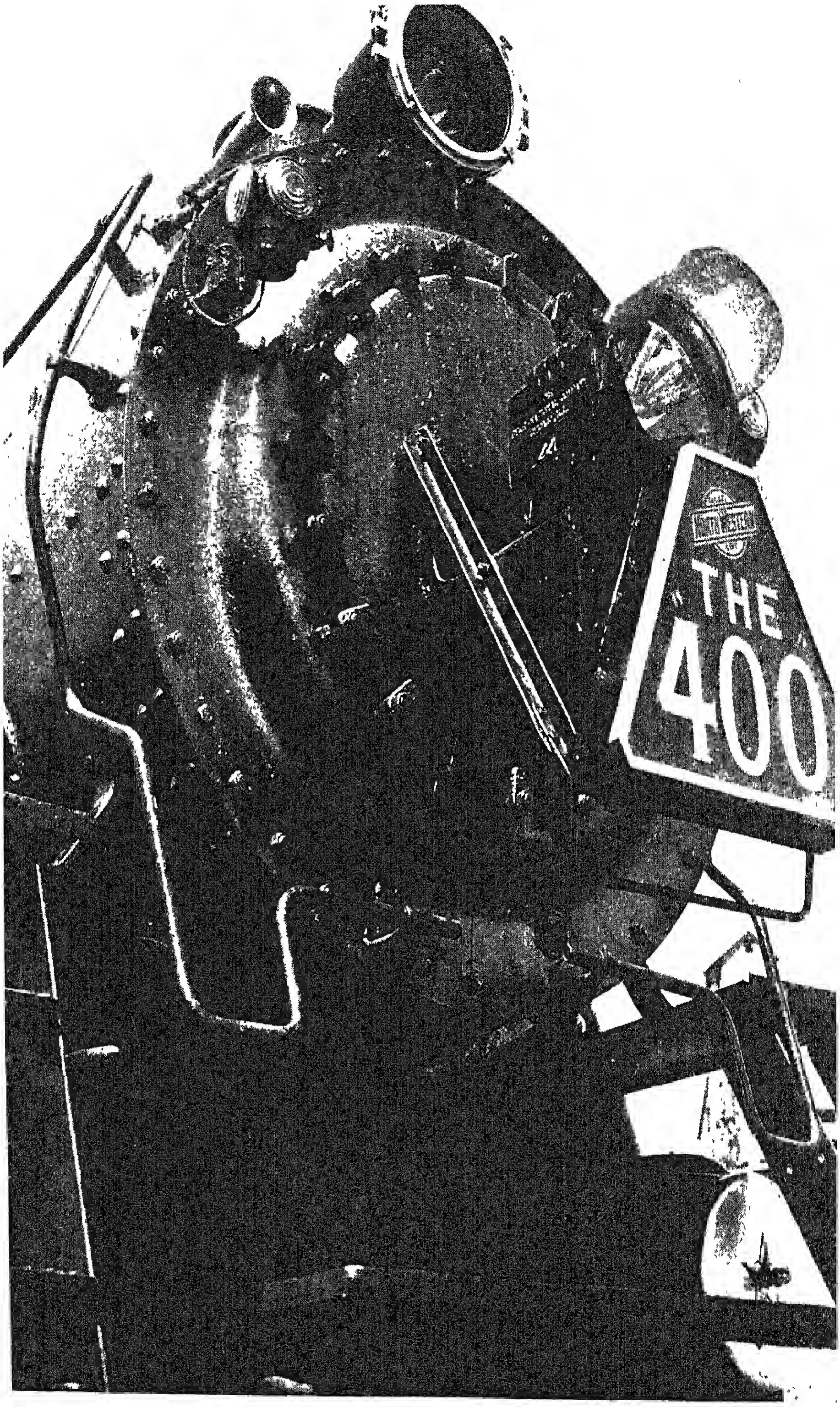
MOLECULES—"In an exhaustive paper upon methods of measuring thin films, Otto Wiener has made certain measures of the thickness of a film of silver which can just be perceived by the eye, and arrived at the conclusion that 0.2 millionths of a millimeter is an upper limit of the diameter of a silver molecule."

TYPEWRITERS—"The typewriter is creating a revolution in methods of correspondence, and filling the country with active, competent young ladies who are establishing a distinct profession, and bringing into our business offices, lawyers' offices, editorial sanctums, etc., an element of decency, purity, and method which is working a perceptible change."

TELEPHONE PATENT—"For the second time the government has met with a reverse in its suit brought to cancel the Bell telephone patent. . . . The government, however, proposes to appeal

### AND NOW FOR THE FUTURE

- "Weather and Sunspots": a step toward long-range forecasting, by Harlan T. Stetson.
- A noble metal wins its place in industry, by A. J. Wadhams.
- An excavated tomb reveals the homely private life of a typical ancient Egyptian middle-class family.
- New light on the subject of the speed at which ducks fly, by S. F. Aaron.
- The existence of contagious disease is an insult to science, by G. H. Estabrooks.

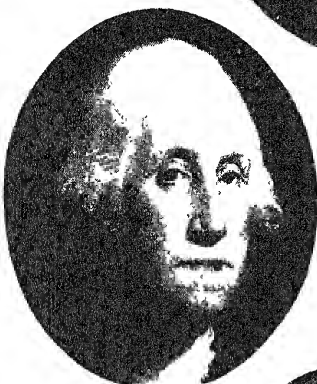



## A GYRATING HEADLIGHT FOR SAFETY'S SAKE

DRIVERS of automobiles only too often do not notice a train's approach to a crossing until too late. Even at night the glare of the ordinary headlight is not sufficient warning. Therefore the "400," crack passenger train of the Chicago and North Western Railway, is equipped with—besides the standard headlight—an oscillating, 3,000,000 candlepower light in front of the smoke stack. A motor operates the reflector to swing a powerful, figure-8 beam 800 feet in diameter at 1000 feet distance. It warns by its sweeping movement through the air and its flashing on roadways and against cars.

WOODROW
WILSON

WARREN G.
HARDING



?

INTROVERTS OR EXTRAVERTS?

Of the six, which four
are introvert types?

?

GEORGE
WASHINGTON

CALVIN
COOLIDGE

FRANKLIN D. ROOSEVELT

HERBERT HOOVER

# INTROVERTS AND EXTRAVERTS

MISUNDERSTANDINGS in business and social life frequently may be traced directly to conflicts between introverts and extraverts. Such conflicts, perfectly familiar to psychologists, are created by the cleavage between these two types of personalities, but the gap can usually be closed by a bridge of mutual understanding. To the introvert, an extravert frequently acts in an inexplicable manner. To the extravert, the mental processes of an introvert are often as mysterious. If only it were possible for extraverts and introverts to exchange personalities for even a day, it is likely that there would be much astonishment when the vastly differing mainsprings of action of the two types were disclosed, one to the other.—*The Editor.*

## Most of Us are One Type or the Other and When We Understand the Wide Differences in Outlook, Some Puzzles in Business and Social Life are Resolved

By PAUL POPENOE, Sc.D.
Secretary, The Human Betterment Foundation
Director, The Institute of Family Relations

LOOK at a group of inventors, then at a parade of Shriners. Observe the people you find reading in the Science and Industry room, or in the Poetry Nook, of the public library, then attend a caucus of ward politicians.

In each case you will recognize that you are seeing different types of people—different not merely in occupation, training, and mentality, but equally in temperament and body-build.

The first group in each case is made up predominantly of introverts, the second of extraverts.

Broadly speaking, the introvert is one who, as the word suggests, has his attention turned in on himself. He is concerned with his own thoughts and feelings. The extravert has his attention turned outward. He is more concerned with what is going on around him.

Wild animals, so far as one can judge,

react in what would be considered an extravert manner; hence this is by some writers (particularly in Europe) called the primary type of personality. The introvert is then designated as the secondary type.

The two types differ radically in behavior, though with much overlapping. The introvert is more inclined to be neat, perhaps even fussy, about such

HUEY P. LONG
Undoubtedly he was an extravert

personal habits as eating and dressing. He is sensitive, blushes easily, is deeply affected by either praise or blame, is conscientious to the point of worry, and enjoys a painstaking, detailed job. He does not push himself forward but speaks when he is spoken to. The emphasis of his make-up being on the processes of thought, he tends to withdraw from reality and to be concerned constantly with himself. Though he desires continually to assert himself, he often fails to do so because of some inner restraint or inhibition that results in a paralyzing condition of embarrassment. He becomes retiring and timid, and it is only when he is on the way home that he thinks of all the bright things he might have said at the party.

The extravert is the opposite of all this: he is not self-centered, because his interest is more on what is going on around him than on his own mental processes. He is always ready with a laugh and a retort, is likely to be a bit aggressive and not easily squelched. He enjoys sports and outdoor life. His tendency is to reach out and make social contacts; he is expansive and expressive; any thought that occurs to him finds ready issuance in conduct.

These differences are not associated with intelligence. They are, however, related to physique or body-build. The introvert temperament is found more frequently in the asthenic body-build, a slender physique sometimes called the linear type because the characteristic lines are vertical. The extravert is more likely to be of the lateral type, characteristic lines being horizontal. He is more thick-set and sturdy; often, though not necessarily, shorter. Calvin Coolidge and Colonel Lindbergh are good specimens of the asthenic introvert. The extravert and his body-build, commonly called pyknic, are seen to perfection in such men as David Lloyd-George, Aristide Briand and Edward Herriot, Huey Long and "T.R."

These two contrasted human types have been recognized throughout history, in mythology, and in symbolism. Don Quixote and Sancho Panza represent the classical portrayal in literature. Uncle Sam is always pictured as a lean, shrewd, laconic Yankee; Santa Claus as a short, thick-set, good-natured and generous extravert. One can not imagine a rotund Uncle Sam whose paunch "shook, when he laughed, like a bowl full of jelly"; nor a "lean and hungry" Santa Claus resembling the "yon Cassius" whose appearance annoyed Julius Caesar.

This body-build is of course associated with all sorts of internal differences. The introvert tends to have a poor circulation, while the ruddier countenance of the extravert not only suggests his better constitution, but warns that he is more likely than his opposite to suffer from high blood pressure associated with kidney defects, also with paralytic strokes, with gall-bladder disturbances and pernicious anemia. He tends to have more active glandular secretions than does the introvert. The latter has a greater liability to stomach ulcers and to tuberculosis.

AS the body-build is inherited, so is also the temperament that goes with it. But, since all of us have highly mixed ancestry, both types may be found in the same family. One child may be an unmistakable introvert, his brother or sister just as definitely an extravert. In all races, both extremes are found, though perhaps in somewhat different proportions.

Just how far is temperament inborn, and how far dependent on childhood training or surroundings? Undoubtedly it can be influenced by the latter, but its association with body-build suggests that it is not a mere acquisition, a product of education.

Women are somewhat more introvert than men. This might at first sight be explained as due to differences in their upbringing and social outlook; but the fact that most of them become still more introverted during the menstrual period (only one in every 200 reported increased extraversion at that time) indicates that it may be associated with glandular balance. If so, glandular changes in the course of one's life might lead to a general shift in one's balance of temperament. Illness also tends to increase introversion.

The individual who knows his own makeup should plan his life intelligently in the light of that knowledge. The man who feels that he tends to be too introverted for his own good should keep up his physical health; then he should enlarge his interests, study other people, and try to take part in their interests. Day-dreaming must be particularly shunned, unless it is of creative character that may be expressed in profitable action.

The extravert will do well to harden his body, and then strive for independence, self-control, and the habit of reasoning. He is likely to be too responsive to those around him and when someone comes along with a new scheme, he may at once embrace it and want to see it put into execution, but is ready to drop it and take up the next one that comes along. The extravert is likely to become a yes-man (or perhaps, in the home, a yes-my-dear-man). He may always be too inclined to "go with the crowd" and accept too little responsibility.

The two types must guide themselves differently in the use of alcohol, one effect of which is to make the individual more extravert. The introvert can, generally, stand the most liquor. In fact, many introverts use it for so-called "social" purposes—in reality to increase

CHARLES A. LINDBERGH
Shy. Plans carefully. An introvert

their extraversion. The extravert is already at the edge of safety, and alcohol pushes him over the edge. In other words, he is likely to become drunk on a good deal less alcohol than the introvert can tolerate.

Because the wild animal is apparently an extravert except when sick, this "primary type" has sometimes been thought to be the ideal. H. C. Link, in his recent popular book, "The Return to Religion," encourages extraversion so much as almost to make one think that it is synonymous with good mental hygiene. A broader biological perspective will show that some are born looking outward on life, others inward; that one can not greatly change his own temperament; and that each has not only its

own contribution to make to civilization. *The introvert provides a large part of the creative intelligence, while the extravert makes the wheels go 'round.*

Since the type of temperament is observable from childhood, sometimes even from the cradle, it should influence the education of children. The introvert needs to be pushed out and socialized. Without wise handling, it will be too easy for him to be tied to his mother's apron strings, to shun contacts with other people, and thus to find, especially at adolescence, unnecessary difficulty in taking his place in the ranks. The extravert, on the other hand, may need to be kept within bounds and encouraged, so far as possible, in habits of industry and concentration, in order to prevent him from growing up into an irresponsible and superficial show-off.

## What About You?

**If you answer most of these questions with "*Yes,*" you are probably an introvert; if with "*No,*" an extravert.**

Do you prefer to be by yourself rather than in a crowd?

Do you plan a job in great detail before you start it?

Do you indulge a good deal in day-dreaming, in plans for the future, or in thinking what you may be doing ten years hence?

Do you keep a detailed personal diary?

Do you like cross-word puzzles?

Do you go on the principle that "haste makes waste"?

Do you prefer to save money rather than to spend it?

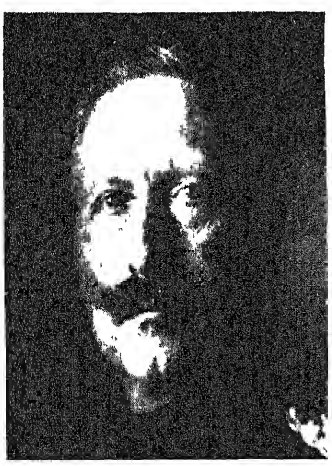
Do you often rewrite your letters?

Do you stick to a job that has lost interest to you, just because you think anything started ought to be finished?

Do you feel that one should be very slow about giving his confidence to a friend?

Obviously, vocational guidance must also take account of these patterns. The inventor, working alone in his laboratory with his dreams; the poet, sitting in his garret and clothing his fantasies with the semblance of reality—such men can be thought of only as introverts, just as surely as the successful bond salesman, the affluent mortician, and the regularly re-elected district attorney will be thought of as extraverts.

With many individual exceptions, one will find actors, orators, preachers, adventurers, bluffers, squanderers, promoters, humbugs, mostly extraverts. Yet there are differences within the professions. The pastor of a wealthy and fashionable city church is likely to be an



WILLIAM HOHENZOLLERN
Many believe he is an extravert

extravert, but the fanatical evangelist with fundamentalist leanings may be an introvert. Again, one could not conceive of Edgar Allan Poe as anything except an introvert, while Walt Mason and Edgar A. Guest might well be extraverts.

Extraverts are found to make the best shop foremen, while introverts are the best inspectors.

Among women, it has been found that those who choose nursing as a career [illegible] to be extraverts. The average of a group tested was more extravert than 94 percent of all women entering colleges, and the most introvert nurse in the group was only as introvert as the average college girl. Definite personality traits in which the nurses were more extravert than college girls are:

- Nurses remember better the details of things to be done.
- Nurses move more quickly.
- Nurses prefer working with others.
- Nurses are more ready to share things, even at personal sacrifice.
- Nurses give less attention to personal appearance.
- Nurses are less inclined to day-dream.
- Nurses are not as self-conscious.
- Nurses are less reserved about making acquaintances.
- Nurses are less moody.
- Nurses blush less.

One of the inferences to be drawn is that a girl who is an introvert should not be encouraged to consider nursing; she will probably fail at it—the greater emotional sensitivity of the introvert doubtless helps to unfit her for that career. A canvass of laboratory technicians, on the other hand, would probably show an excess of extraverts.

Women teachers are largely introverts, and the longer they have taught, the higher they average in introversion. This may be partly due to the influence of their daily life, but has also been explained as the result of a selective process. The extraverts, it is supposed, are more likely to marry and drop out of the profession; hence among those who are left after 20 years, one would find a higher proportion of introverts than in the student body of a teachers' training college.

The vocational counselor, trying to get the round pegs into round holes, makes use of all these facts. Miss A., for example, is a P.B.X. telephone operator in an apartment house. She sits behind a screen and sees no one except the postman, who unfortunately never has time to stop and talk. She is intensely unhappy because—although she does not recognize the reason—she is an extravert in an introvert's job. A counselor advises her to give up the job and demonstrate mayonnaise in a grocery store, where she can talk to every one who comes in, and can even follow them around among the shelves. She says it is simply heavenly!

Similarly, Mr. B., an extreme introvert, has been trying to make a living as a door-to-door canvasser. He is not only miserable, but is getting nearer to bankruptcy each day; retired from circulation and put into a photographer's darkroom where his painstaking attention to detail is invaluable, he makes a success.

IN marriage, there is a slight tendency for the introverts to be less happy. They tend to brood more over their troubles, possibly have less of a normal social life, and are more sensitive. But the wide observations of the Institute of Family Relations indicate that this is not a major factor in marital harmony.

It has often been suggested that an introvert and an extravert would be mismated, one talking too much and the other too little. This idea is hard to reconcile with the fact that it is the wife who is more likely to be introverted, yet it is notoriously the wife who is charged by her husband with talkativeness, while a large proportion of wives complain that their husbands are not sufficiently conversable.

The Institute's studies show that almost any combination will succeed in finding conjugal happiness if husband and wife really try to do so—if they know their own weak and strong points and use that knowledge intelligently.

Mrs. C., as an illustration, is dissatisfied with her husband because he is not a social butterfly. He is "a good pro-

HENRY FORD
**Probably mainly an introvert**

vider," but she thinks he ought to shine more conspicuously at bridge parties and at the monthly socials given by the Woodmen of the World. If she understands something about introversion and extraversion, and realizes that her husband belongs in the former classification, she is less likely to ascribe his reticence to "pure orneriness."

Biologically, just what is it that makes a man either introvert or extravert? Doubtless the ingredients are many, but one of the most important is supposed to be the resistance of the synapses. The synapses are the somewhat hypothetical mechanisms through which nervous impulses are transmitted at each point where two neurones come together. One may form a crude mechanical picture, for the present purpose, by considering the wiring of a radio or any other electrical circuit. If the joints are well soldered, the resistance is low at these junctions, and a current will flow through easily. If, on the contrary, the joints are loose, there will be a high resistance at each of them, with a greater likelihood that the current will be stopped, or will flow off at a tangent.

IN the introvert, it is supposed that the resistance of the synapses is low and that a nervous impulse therefore travels around easily. To speak very diagrammatically, the introvert's ideas circulate 'round and 'round in his mind and stay there, because that is the line of least resistance. The extravert's synapses, on the other hand, offer a high resistance to the circulation of an idea, hence it tends to branch off and express itself in action, instead of remaining in the closed circuit of thought processes.

The introvert's emotional life, as a whole, is different in quality from that of the extravert. His emotional states are complex and play on each other. Conflicts are met by repression, and can be dealt with by psychoanalysis.

The extravert's emotional states are more simple. Each tends to be expressed immediately, without interference by others. Severe conflicts are met by dissociation—they are "split off" in the personality. Hence the extravert lends himself well to being hypnotized, since that is a process of dissociation. It is virtually impossible to hypnotize some introverts—their minds are not built that way. But the attempt to psychoanalyze the extravert is equally difficult, because his emotional life is not built up on the repressed complexes which the psychoanalyst seeks to uncover and release. A study of some of the patients who became insane during the process of psychoanalysis showed that they were predominantly extraverts. The psychoan-

WILL ROGERS
**An extravert—he liked people**

alyst should not have attempted to work on them, for there was nothing to work on.

If the emotional difficulties increase to the point of a neurosis, it will be of radically different type in the two cases. The introvert's conflicts, being repressed, will result in the tension and confusion of neurasthenia. The extravert's conflicts, being split off for the protection of the rest of his personality, will end in hysteria with its bizarre symptoms of dissociation—one part of the body, or one part of the daily life, seeming to exist quite independently of the rest.

The same far-reaching difference is found if the patient actually becomes insane. The introvert will end up as a victim of dementia praecox. His personality becomes more and more shut in, his daily life more and more cut off from contact with the world around him. He "crawls into his shell," in extreme cases, until he appears to lead a sort of vegetative existence. He has been likened to a larva spinning a cocoon around itself. He may give no sign of recognizing what is going on around him; one would say that he had almost lost consciousness; yet an occasional rift in the cocoon reveals an active mental life going on inside. But it is a perpetual sort of waking dream-life. It does not issue into action.

The extravert, in the extreme case, will break down with manic-depressive insanity, in which a period of despondency or melancholia typically alternates with a manic period of intense, sometimes frantic activity. In the latter stage he may commit a crime of violence, or merely wear himself out. In the depressed phase, suicide is a common termination.

However, the mere fact of being an extreme introvert or extravert, as the case may be, does not at all mean that one is destined to break down with the appropriate mental disease. I am merely trying to point out that the two types of personality are so distinct as, in abnormal cases, to end in quite different ways.

INTROVERSION and extraversion themselves must be considered normal aspects of the personality. Most of us represent a balance between the two tendencies. We are ambiverts—we can react in either way, according to circumstances. Similarly, most of us are of medium height or weight, by definition. But, just as we recognize in a crowd some unusually tall or short, fat or thin, so we shall recognize among our friends some who are unusually introverted or extraverted. We shall probably recognize that the tendency runs

CHARLES P. STEINMETZ
**Creative intelligence—introvert**

in their families as well; and that it influences their daily lives in sickness and health, from infancy to old age.

One can not change his make-up radically, but in ordinary circumstances he can keep it within bounds and use it effectively instead of inefficiently.

The first thing, then, is to recognize one's own temperament; the second, to recognize that of others. In the light of this knowledge, one will not expect an introvert to behave like an extravert; and he will find an explanation for things that have formerly seemed obscure, in business, politics, religion, or social life. A wider acquaintance with these facts of personality would do much to make human relationships more harmonious and promote personal welfare.

# OUR POINT OF VIEW

## Precaution

DISREGARDING for the time our feeling that stunt flying should be curbed—we have made our position in this respect clear in past issues—there are other aspects of long-distance flight over water that warrant careful consideration. Although the tragic Earhart-Noonan flight has long since passed from the front pages of the newspapers, it has left a bad taste in the mouths of those directly concerned with the future of aviation. Particularly is this true of technicians who have placed so much faith in radio as the mainstay of those who fly over the sea in ships.

The anxious days and nights of waiting for word of the courageous if somewhat foolhardy fliers, the valiant efforts of the United States Navy and Coast Guard, the vague whisperings variously reported, all are now history, history that we sincerely hope will not be repeated. From a study of the conditions surrounding the Earhart-Noonan flight come questions that, answered by technical advances, will do much to forward safety of life in transoceanic flight. Radio compasses on board ship are available only on the 500-kilocycle ship band. Reception on this band demands 500-kilocycle transmitters on airplanes, and such transmitters require trailing wire antennas for efficient operation. These antennas are usable only when the plane is in flight; forced down, the wire may, first, cause a crash if it is not wound up, and, second, become useless if the plane lands on water. Short-wave radio compasses are technical possibilities; their use in airplane service is strongly indicated; their range would be greater per watt input in the transmitter than when operation is carried out on the ship wave band. The radio homing device, which requires only tuning to broadcasting station signals, also offers possibilities that should not be overlooked.

At the present time, the 500-kilocycle band is the only one on which it may be said that anything approaching a 24-hour-a-day watch is maintained by commercial and naval ship and shore stations. With the increase in aircraft traffic, it would seem logical to develop, at least on board naval vessels and in naval land stations, a similar schedule on one or more of the airplane frequencies. If this is not possible, the alternative is to compel all airplanes flying over oceans or other dangerous territory to carry equipment that can be used in the 500-kilocycle ship band—and to carry operators who know how to use it.

Commercial operation of airplanes in the South American and transpacific service shows what can be done by large organizations working on carefully thought out schedules, with the best equipment for the purpose and with highly-trained personnel. The Bermuda route now in operation and the projected transatlantic service will place more and more of the public in positions where every contingency must be foreseen and provided for. Radio is the only link which man has forged that can bridge the gap between planes at sea and the safety of dry land. No possibility should be overlooked in forging the girders of this bridge, that it may be so strong as to be infallible.

## Science or Sonorousness?

THE title of a paper—"Influence of Sulfhydryl and Sulfoxide on Chromosome and Aster Dimensions in Regenerating Tissues of Clymenella Torquata" —delivered by a physiological chemist, has been the subject of merriment because it sounds sonorous. Nevertheless this is all good, legitimate, and really *compact* descriptive language. Unlike it is a sentence from a paper delivered by an entomologist: "It would appear from what evidence is available that the act of oviposition is immediately stimulated by the crepuscular diminution in the intensity of illumination and the rise in relative humidity as the diurnal temperature increases," meaning that twilight and evening dampness stimulate egg-laying, and reminding one of the old-style professor who exclaimed, "Dear me, I fear I have excoriated the cuticle of my digit." He had cut his finger.

Science properly aims toward simplicity.

## Predictions

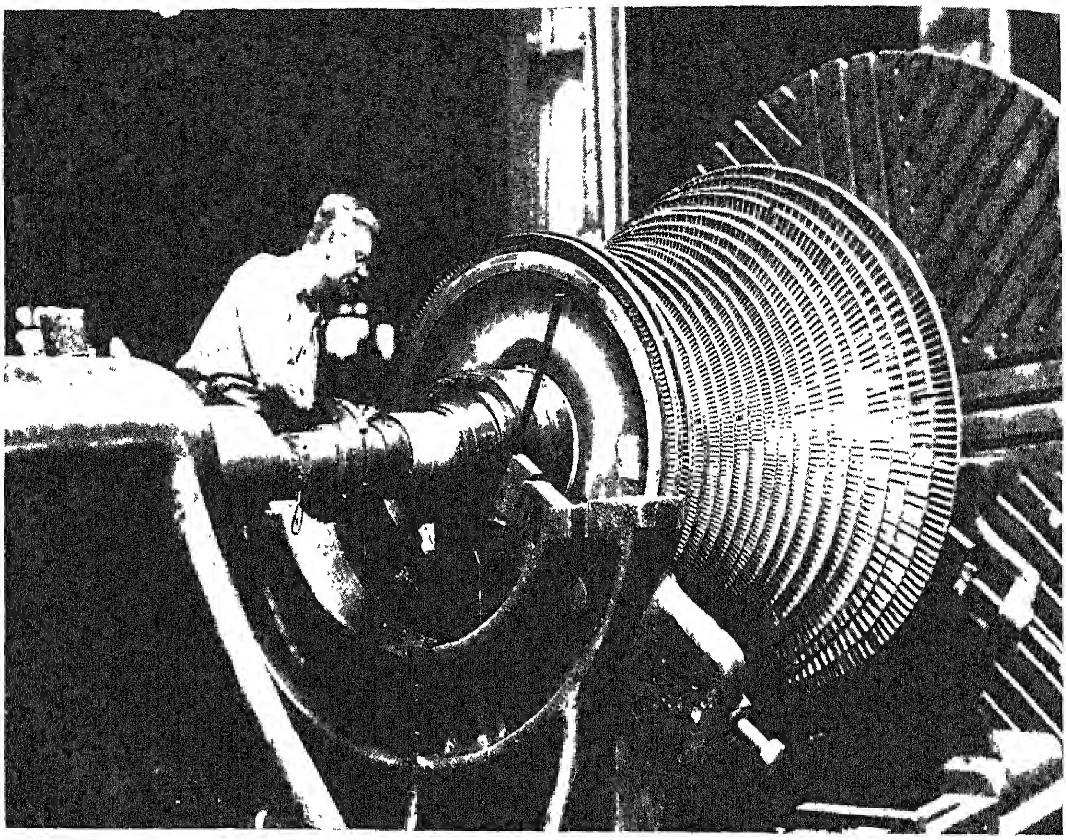
LET'S assume that man is a perspicacious animal. He must be; consider his mighty works, his scientific achievements, his multitudinous plans and programs for future happiness, welfare, riches. A glimpse at a part of his record should tell us something.

A few years before the day in 1903 made famous by the Wright brothers at Kitty Hawk, a noted scientist stated positively that man would never fly. In the vernacular: "What a bust!" Another came at the time Roentgen first announced the X ray. One world authority said: "Interesting, but it can never be more than a laboratory curiosity." Radio was opportunity knocking on Edison's door; he had it within reach at one time but he turned to something else. This journal reported in 1853 a doctor's description of an air conditioning system essentially as we have it today, yet we had to wait more than half a century before an industry was built upon it.

Perhaps, after all, man is not so keen as we assumed, for these few examples might be multiplied by the score. Bear in mind that experts were concerned in the above-mentioned failures to read the future rightly. Nowadays even the man in the street knows better than to say "It can't be done," for he believes science can work any miracle. But that is not prescience. If man were clairvoyant, he might have foreseen the social and economic implications of the incandescent lamp, the automobile, radio, aircraft; might not have said as David Starr Jordan did early in 1914: "This inevitable war people have so long discussed won't come because it can't come"; might have avoided the world economic collapse of 1929! If man were so clever as that, we would not have been treated recently to the glorious sight of billowing sails in races (?) off Newport for the honor of winning or holding a silver mug. The contestants knew how much their yachts cost, the distance around the course, all the factual details. Why not call off the races, predict results by theories or mathematical calculations, let it go at that? Why not? Because there were too many uncertainties!

Life and work, all human endeavor is like that—influenced, assisted or handicapped, encouraged or defeated by wind and weather and the vagaries of unstandardized human nature. Uncertainty is the rule, not the exception.

Why, then, a group of impractical professors of the National Resources Committee can expect other committees (which they urge) to predict future inventions or the social and economic implications of existing ones is a puzzle to us. This group spent months studying the question and submitted to the President a report of something like 450,000 words. One might say, offhand, that the committees suggested would really do no harm and that their appointment would elicit some amusing theories to put a smile on our faces. But then, they would be using taxpayers' money, as the reporting committee did! Who wants to extend our tax burden to pay for the highly dubious activities of groups that can never be as expert specialists as those who failed in the examples quoted above? Not we! The uncertainties of droughts and hurricanes and the stupidities of man in an era cursed with the existence of numerous megalomaniacs are *too certain* and unpredictable!



Thousands of blades, or buckets, radiate, row on row, from the shaft of a steam turbine rotor

# MASS POWER

## Steam Turbines Most Efficient Power . . . Run Red Hot . . . Higher Pressures . . . New Bucket Construction . . . Metal Technology Brings Improvements

By PHILIP H. SMITH

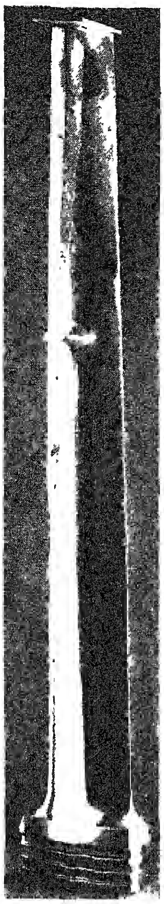
DESPITE great projects for harnessing water power for the generation of electric current, and the millions of kilowatts being made available by the simple process of making water work as it runs down hill, steam remains the principal generative force for the production of mass power.

In the year ending March 31, steam turbines produced about 70 percent of the 109 billion kilowatt-hours consumed in this country, and if the struggle of turbine manufacturers to fill orders for central station equipment is any criterion, this percentage is going to endure or become even larger in the coming years.

There is no mystery in this predominance of steam-produced power. The turbine is the most efficient generator yet devised, when both prime and operating costs are considered. It dominates because it has become steadily more efficient as demands for cheaper power have driven engineers to improve its qualities. Since the turn of the century, turbine capacity has grown from 500 kilowatts to 75.000 kilowatts for the single case machine and to 200,000 kilowatts for the compound type. At the same time, the power station rates of energy consumed for current produced have been reduced from 30,000 B.t.u./Kw.hr. to less than 12,000 B.t.u./Kw.hr. This means a reduction of more than one-half in fuel consumption so that today's turbine gives forth the equivalent of the work of 13 men for one hour for every 12 ounces of coal burned.

A MODERN commercial turbine does things which were physically impossible 30 years ago; perhaps its functioning was not even dreamed by the most radical of engineers of that time. For example, a turbine can take in steam at 1200 pounds pressure and 900 degrees, Fahrenheit, temperature and one-thirtieth of a second later, after the steam has expanded a thousand-fold, the machine will expel it 821 degrees cooler and down to absolute pressure of one inch of mercury. The rotor of a complete expansion type machine, which may weigh as much as 60 tons and rotate at near red heat, attains so high a velocity that the blade tips reach the amazing speed of 14 miles a minute! Such a turbine must pass a terrific volume of steam. One machine of 165,000 kilowatt capacity, recently put into operation, passes over 12,000,000 cubic feet of steam per minute to the condenser at full load. That's enough to form a sphere of steam 284 feet in diameter every minute of operation.

Performance of this magnitude has been achieved by slow and painstaking steps, rather than by startling discoveries. It is fruitless to search for a simple explanation which will reveal how present efficiencies have been obtained and what the future holds in store for the turbine. The basic principles were laid down centuries ago, first in the Hero



A typical large, reaction blade such as is used in the last rotating row of a condensing turbine. Lower end fits into slot in rotor; upper is free end

engine of 130 B.C. and later by the Branca wheel of the Seventeenth Century. These inventions gave the "impulse" and "reaction" principles in use in varying combinations today. Then, after Sir Charles Parsons, the British engineer, began his work in 1884 to give the turbine commercial practicability, many contributed to make improvements by a process of slow accretion.

*The outstanding feature of* the modern turbine is the high steam pressures and temperatures at which it operates, and if we keep our eyes focused upon this fact and discover how it came about, we will find all noteworthy developments passing in review.

Elevating both pressures and temperatures has long been the goal of turbine engineers because of the higher efficiencies it makes possible. Their success may be measured by the fact that pressures have been raised from 150 pounds per square inch to 1400, while temperatures at the throttle have been increased from 360 degrees, Fahrenheit, to 950.

Higher pressure raises a serious problem. It results in greater deposition of moisture during expansion, which in turn causes a pitting of the blades when they strike the moisture particles in an atmosphere of extremely low pressure, and it otherwise affects efficiency of the elements. To solve the problem, engineers, in some cases, have employed re-heating of the steam; that is, steam is extracted from the turbine after partial expansion, is re-heated, and is returned to the turbine to finish its work. This practice reduces the moisture content, but it has not been looked upon as a wholly satisfactory solution because it involves large piping. A more recent practice has been to raise temperatures so that re-heating can be avoided and still keep the moisture content below 12 percent, which is considered the maximum permissible.

A satisfactory solution to the blade problem has been found by using the most recent advances in metallurgy. But pitting at the low pressure end was not the only trouble to be overcome. The higher velocities necessitated stronger blade construction and use of materials that would maintain form. From non-ferrous alloys, to steel, to low carbon steel containing nickel, and finally to stainless steel, traces one path of blade or bucket development. Now we find the wearing-away action being checked by silver-soldering thin strips of Stellite to the stainless steel body of each blade.

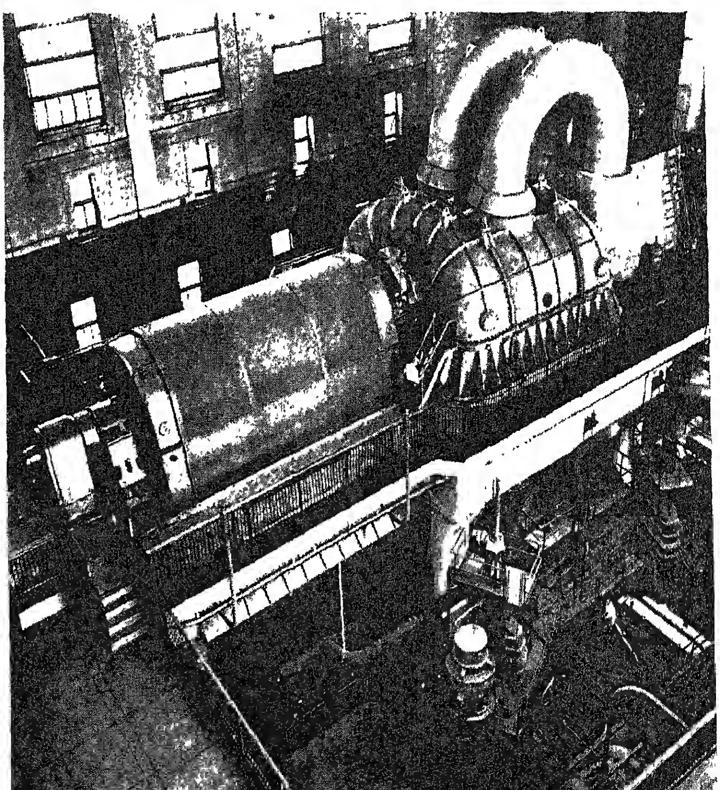
Higher steam temperatures, while reducing moisture content, raise problems of their own. Steam consumption is reduced about 1 percent for every 10 degrees Fahrenheit of superheat, and such reductions are desired; but with the advent of superheat came the phenomenon of "growth," or warping, in the cast iron pipe fittings and turbine casing. Then, as the temperatures were pushed higher, there followed the phenomenon of "creep," which is the tendency of metals to stretch more or less continuously.

Once again metallurgy came to the turbine engineers' assistance. Cast iron was abandoned in favor of alloys containing such metals as molybdenum, which has resistance to corrosion and embrittlement, nickel, and chromium. One of the most satisfactory alloys in use is a chromium-molybdenum-steel.

Metallurgy has played a dominant role in the last 10 years of turbine development and it should be given full credit. Without knowledge of the newer alloys, the present turbine would be impossible. Stability of metals is an essential to proper functioning as one instance alone will show.

Any one conversant with the turbine knows that there must be minute and accurate clearance between blade tips and the rotor housing, because if steam leaks past there will be loss of efficiency. Much has been written about this phase of turbine construction because it rouses a feeling of amazement to think of the blades whirling around at 14 miles a minute with less than a visiting card thickness separating them from the stationary housing; less has been written about what happens if for any reason the clearance is not maintained and there is contact. The older methods of trusting to proper clearance were wholly inadequate when high heat and pressures came in and so there had to come a threefold solution to the problem—making the blades better, improving the housing casting, both of which have been touched upon, and, finally, in the reaction type of turbine, by increasing the blade clearance and spanning the gaps with strips of stainless steel containing molybdenum, thin enough to wear away without damage if there should be contact.

NEXT to high temperatures in importance as means for achieving greater efficiency, comes feed-water heating by extraction. This practice involves extracting partially expanded



Installation view of a 165,000 kilowatt turbo-generator

steam from various stages of a turbine and condensing it in a series of feed-water heaters. A high thermal efficiency is obtained because the heat of evaporation goes back into the system instead of being lost in the condenser cooling water.

Much of the progress in turbine efficiency has come from developments external to the turbine itself. Electric generator design has been a very important contributor, and so have condensers. Early turbines could not operate at maximum efficiency because rotative speeds were low and these speeds could not be raised until generator capacities at any given speed could be stepped up. While turbine designers were at work on their own problems, the electrical engineer got busy on his and soon generator speeds were raised so that they now meet the turbine on even terms. Higher permissible turbine speeds have enabled the designer to increase velocity ratios (the ratio of blade speed to steam jet speed) from 60 to 85 percent with a consequent decrease in turbine diameters and reduction of leakage and losses.

The condensers used in conjunction with the newest type of turbine may create a vacuum higher than 29 inches, whereas the earlier type was limited to 25 or 26 inches. This marks another important advance in turbine efficiency. Steam in a turbine can be made to expand to any low limit of exhaust pressure and the lower this limit the greater the amount of work obtained from the steam.

Not all turbines make full use of condensers. There are machines in which partial condensing is employed and others where there is no condensing, albeit, in this last group condensation does take place before the steam cycle is completed. Here we refer to the superposition turbine, which represents about 30 percent of current production.

The superposition machine, sometimes called a topping turbine, is designed to exhaust steam at pressures of 200 to 300 pounds per square inch for re-use in existing lower pressure turbines. In practice, the new turbine is placed ahead of an older one, and its purpose is to raise the efficiency of a power plant without scrapping existing equipment. Were it not for the fact that higher initial temperatures are now possible, this rejuvenation could not be accomplished. As it is, engineers are convinced of its practicability, and 1936 might be designated as a superposition year because of the many installations.

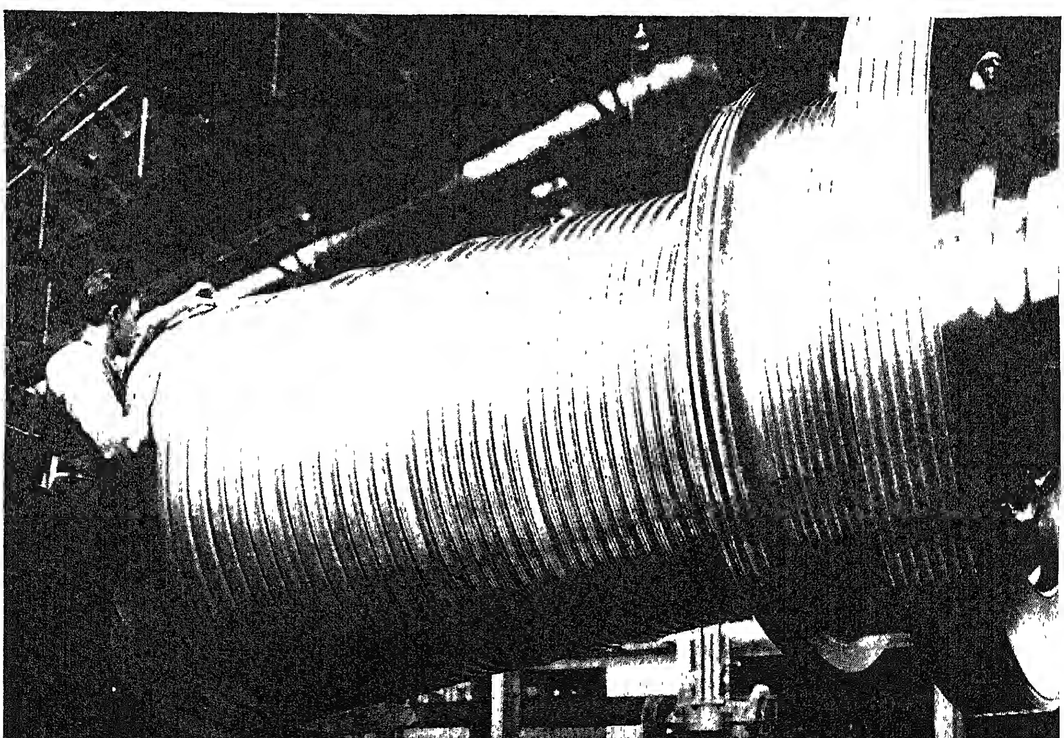
At first thought, the superposition machine might seem a makeshift, but it is not. Extremely reliable and efficient installations can be had by this simple expedient provided the older, low pressure equipment is in good condition. Some designers believe a system which embraces a high pressure unit and a lower pressure one comes near to approximating the ideal.

It is interesting to note that there was a similar practice pursued in 1908. It had to do with using exhaust steam at the low pressure end of the cycle rather than at the high end. The cry was then for equipment to utilize the exhaust steam from reciprocating engines, and to meet this demand low pressure turbines were built. The combination of reciprocating engines and low pressure turbines served to prolong the useful life of the former until inescapable economics forced replacement with more efficient and up-to-date power producing machines.

Turbines which condense only a part of the exhaust steam are those which enter into industrial use as contrasted to central power stations. In this case, a part of the steam is extracted from the turbine for heating or process work incident to manufacturing operations and these latter requirements tend to govern the inlet temperature and pressure of the steam.

If one were to take the significant factors about turbines, such as pressures, temperatures, capacities, and so on, and plot them back to, say, 1900, the graphic presentation would reveal steadily ascending curves for every item save those of weight and kilowatts per pound of fuel consumed. In certain instances there would be sharp upward ascents followed by a leveling off and then another push upward. You couldn't study this picture long without being convinced that turbines had been undergoing long and steady development and the idea might easily be conceived that we are on the eve of another great surge forward. We would then ask: is something new about to break and what about competition from hydro-electric sources and the Diesel engine?

Let us consider competition first and stick to facts that are not controversial.



An unbladed rotor of carbon steel for a 30,000 kilowatt turbine slotted ready for blades

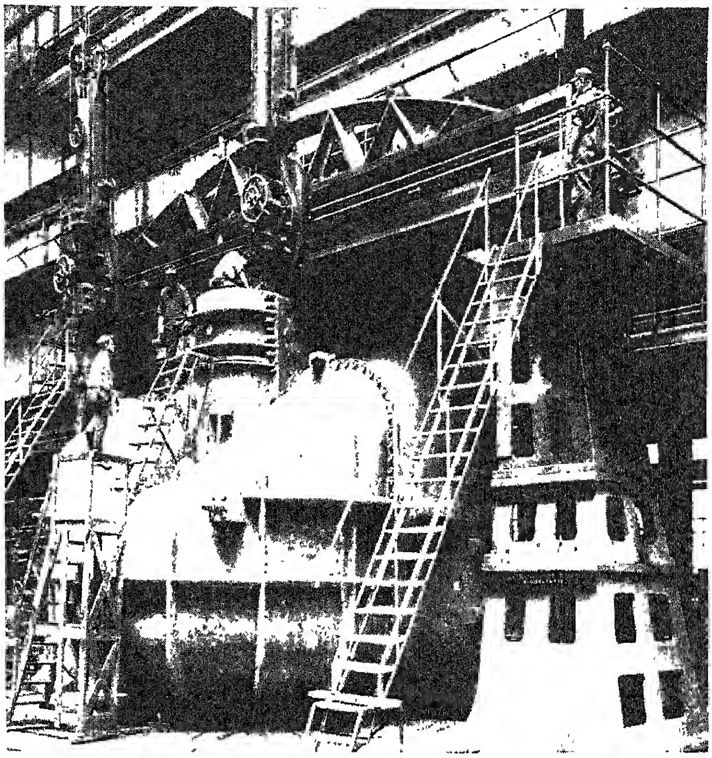
Competition from hydro-electric projects does not offer any serious threat to turbine supremacy when the overall costs of power production are the determining factor. At the moment, water power generation must be subsidized to make it competitive because of the enormous outlay which must precede the first turning of a wheel. Water power is not "something for nothing" as the public is so apt to regard it. A fair estimation of water power cost must include the expenditures made for dams, penstocks, and transmission lines to points of power consumption. Francis Hodgkinson, engineer, whom George Westinghouse brought from England with the first Parsons turbine, has stated that a modern steam power station erected at Niagara Falls, if operated with a good load factor, could probably produce power cheaper than the falls themselves.

THE fact that turbines are the most efficient producers of power does not, of course, eliminate hydro-electric power production from consideration. When one is through arguing the merits and demerits of both systems, the fact remains that water running down hill and doing no work is an economic loss to the community; and, furthermore, coal is a capital resource.

Diesel engines have figured lately in power station news and the proponents of this productive agent foresee further developments of no mean proportions. At the moment, however, Diesels are not headlining mass power production; their forte seems to be as auxiliaries or as boosters for central power stations.

The immediate outlook for development of the turbine promises no such stepping up of temperatures, pressures, and capacities as has been witnessed during the past 15 years. An engine efficiency of 87 percent has been obtained and further operating efficiency is not impossible, but a point of diminishing returns has been reached. The engineer who spends his time designing turbines must keep his eye upon fixed charges quite as much as upon heat efficiency. It has been figured, for example, that a reduction of 10 percent in fuel cost will justify no more than a 7½ percent increase in prime cost.

Perhaps due emphasis can be given to this matter of fixed charges by declaring that a fuelless power station would come up against the obstacle of prime cost. Engineers say that a station using no fuel and having no supervision costs, ideal as it might be, would nevertheless be uneconomical if the prime cost exceeded 160 dollars per kilowatt of capacity. (Present cost is around 100 dollars.) If, at the same time, rates to the consumer had to be dropped, the limit of prime costs would have to be even lower. By so much, therefore, has fuel become secondary to prime costs in the problem of the turbine's future.



Machining a large turbine case casting on a giant lathe

The immediate outlook is for wider use of the superposition turbine because it has proved eminently satisfactory. But industry demands higher pressures and higher temperatures and demands bring action. Improvements are certain to come.

Use of a binary-fluid cycle has been suggested as one method of achieving greater efficiency. This cycle calls for two fluids, one of which will have a temperature at exhaust pressure adequate to evaporate a second fluid. Such cycles are sound and mercury has demonstrated practicability for the higher temperature fluid, but again fixed charges interpose.

Still higher pressures are being projected and there is much promise of success. This calls for a new development in boilers. The existing drum type is inadequate to do the job because of the difficulty of steam and water separation. One suggestion has been to use a boiler in which the water is forced through a continuous tube system to emerge as high-pressure, superheated steam. It is thought that greater safety can be had with this system because it employs small tubes. While no greater temperature or heat would be imparted to the steam, there would be more available energy. A boiler of this type would require a return to re-heating, but since the system promises high thermal efficiencies at practically no increase in prime costs, it affords an attractive problem for engineers to work upon.

Before turbine engineers adopt temperatures higher than 950 degrees, Fahrenheit, some time must elapse for experience to be recorded. As recently as 1931 a temperature of 800 degrees, Fahrenheit, was the maximum employed and not until 1936 did designers venture into the new high range. Turbines are virtually custom made; each one charts a little newer path, and there must be every assurance that improvements will really improve before they are adopted as standard. When a turbine once gets into motion it is expected to stay in continuous motion and give dependable service until inspection time comes around—usually a two-year interval. There can be no time spent in modifying or overhauling it because idleness means loss of revenue.

THERE is much more to steam than James Watt discovered when he observed his mother's tea kettle. The higher ranges of superheat create problems which were unsuspected when turbine engineers began intensive study some 30 years ago. When and if turbines go to much higher pressure and temperature there will be problems of metallurgy again; there may arise difficulties in the lubrication of journals because of the higher heat. There may even be new heat cycles discovered which will raise new problems of their own. Whatever difficulties arise will probably be met, however, because turbine engineers have demonstrated a singular capacity for making this power producer forge steadily ahead.

Photographs courtesy The General Electric Company and Westinghouse Electric and Manufacturing Company.

# PEACE-TIME PREPAREDNESS

## Every Resource Employed in Modern War . . . "Industrial Mobilization Plan" . . . The Part Played by Radio . . . Army-Amateur Radio System

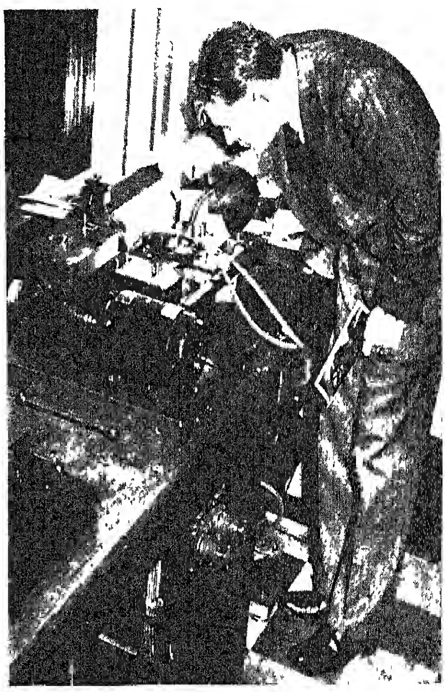
By GENERAL J. G. HARBORD
Chairman of the Board, Radio Corporation of America
Former Deputy Chief of Staff, United States Army

EVERY patriotic American hopes that the United States will never be engaged in another war. Every sensible American, however, looking at the troubled state of Europe today—"a game in which every nation is playing according to its own rules," according to Dorothy Thompson—must refuse to take the ostrich-like attitude that as a nation we are surely done with war forever.

The time is past when wars are fought solely by professional soldiers, or nations defended by "embattled farmers" leaving their fields to seize their squirrel rifles and assemble in the village square. Modern wars are wars of populations in which every industrial and economic resource of a nation is employed.

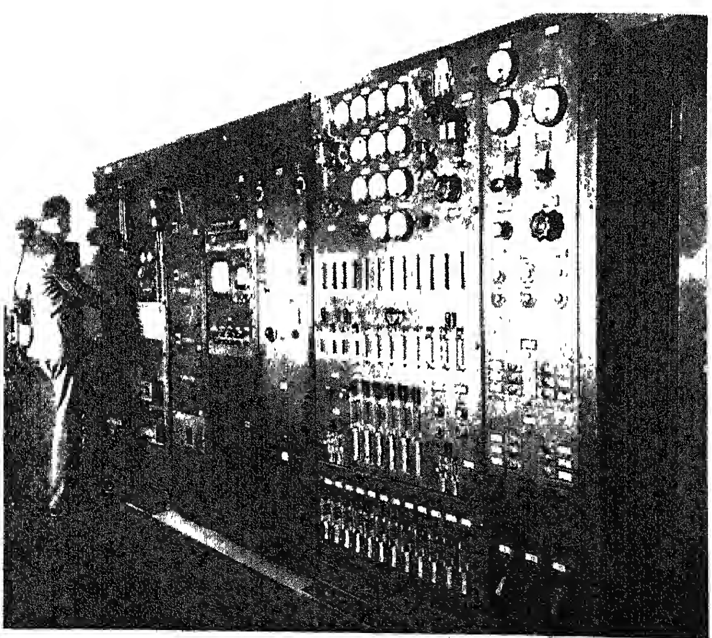
Requirements for national defense fall into three classifications: Trained man-power; munitions and supplies; organization.

The War and Navy Departments have co-operated to prepare a comprehensive "Industrial Mobilization Plan" to insure our industrial preparedness in any possible war emergency. The plan was first announced in 1933 and revised in the autumn of 1936. It establishes a joint Army and Navy Munitions Board to classify and provide for the procurement of the thousands of items of munitions, food, clothing, transport, communication, and other necessities that constitute a national shopping list for war. Huge though the list is, it actually represents an enormous simplification compared with our military inventory of 1917-18. The list of 20 years ago, which comprised approximately 700,000 different articles, is said to have been cut, through scientific planning, to 200,000. Press estimates state that 20,000 factories have been surveyed, of which 12,000 have been selected as potential sources of supply. To describe the war procurement plans of the Army and Navy Munitions Board in all the various fields of American industry would require a book of several volumes. A partial idea of the whole plan may be gained, however, if we take a glimpse at its application to a single industry; for example, that of radio.



Examining an incoming picture on an RCA facsimile recorder. Military possibilities here

Radio was an infant industry when the Armistice was signed. Since then, it has grown to full stature. Feeble radio signals of pre-war days have now been superseded by powerful transoceanic and marine radio-telegraphy linking this nation with every land and with vessels on the farthest of the seven seas. Two thousand and twenty radio stations are now licensed on ships of American registry.



Control panel in NBC's television station in the Empire State Building, New York City. Television developments may play an important part in the next war

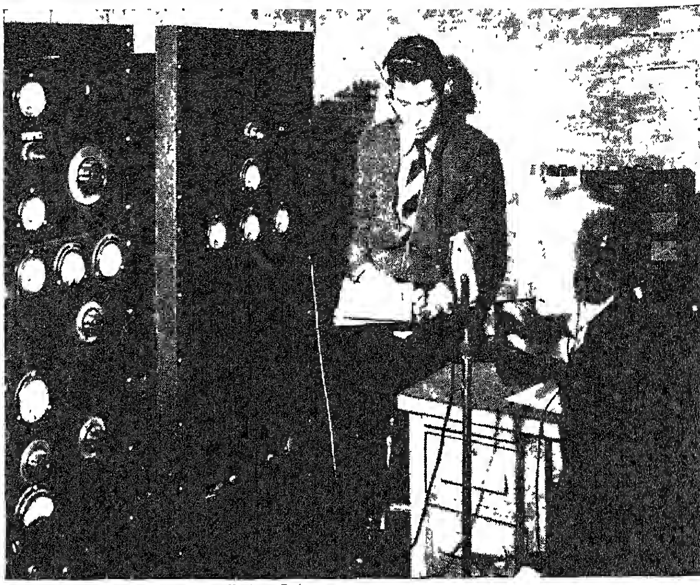
Broadcasting was unknown when the World War ended. Today more than 24,000,000 homes and 4,500,000 automobiles in the United States have radio receivers. Six hundred and ninety broadcasting stations compete for attention in this country. Our radio industry sold 8,250,000 radio receivers and 98,000,000 tubes in 1936—receivers and tubes capable of a performance never dreamed of in 1918.

Radio facsimile, practically unknown during the World War, now flashes pictures and maps through the ether and reproduces them exactly, even across oceans. Engineering field tests of tele-

vision are bringing that art closer to introduction as a practical public service. Research in all branches of radio day by day pushes the horizon farther out. Such industrial radio attainments offer military possibilities that did not exist in the dim pre-war days. Radio will be a vital factor in the next war.

The war procurement plans of the Army and the Navy differ in detail, but conform in principle. We can understand the story by following it through in the Army—remembering always that the Navy has a comparable narrative.

After sources of radio equipment have been tentatively selected, the Signal Corps makes detailed surveys. Ownership and management are studied, as well as quality and quantity capacity. Under the Industrial Mobilization Plan the Signal Corps has surveyed approximately 1400 manufacturers of electrical communication equipment—including all principal radio plants—and selected about 400 as sources of supply. The Navy has conducted similar extensive surveys. Data has been obtained not only from individual companies, but also from the Radio Manufacturers' Association.



Photos above and below courtesy *All-Wave Radio*

**Amateur operators at W8FIC did meritorious work during the last Ohio Valley floods, proving again the value of amateur radio to the country at large**

**Part of our "radio reserves": National Guard Station W8MGD, Corp. George Dively at key**

Selected manufacturers are requested to sign a statement—though not a contract—expressing willingness in emergency to enter into an agreement with the authorities to produce certain items within a certain time. The procedure culminates in written plans, a separate one for each item, containing concise shipping information.

To avoid the raw-material scramble of the early days of the World War, commodity studies coördinated by the Joint Munitions Board are an important part of Army and Navy Planning. As an illustration of the thoroughness of this phase of our industrial mobilization

relatively insignificant material—mica. Mica is a "strategic" material, largely imported. Radio tubes, aviation spark plugs, and some ordnance items require it. An officer of the Signal Corps is Chairman of a special Committee on Mica, and the membership includes officers from the Air Corps and Ordnance. It is the function of this committee to be thoroughly familiar with diversified sources of supply outside the United States, with potential new sources within our own borders, with the development of possible substitutes, with our current industrial inventory, and with both our peace-time and war-time requirements. In case of war the committee would be in a position to build up our national stock of mica with a minimum of delay.

In a rapidly developing industry such as radio, with laboratories constantly making new inventions, plans for full industrial preparedness would be lax indeed if they assumed that progress and invention in the industry had ceased, and if they stopped with equipment now available. If in an approaching day television becomes a practical, far-seeing military eye, as well as a keen ear, plans should be ready to take full advantage of the newest developments. Both the Army and the Navy maintain constant liaison with radio's industrial laboratories and with the Radio Manufacturers' Association. Every advance is studied for possible military application.

Radio personnel is really a phase of its industrial mobilization. Quite aside from the supply of excellent apparatus

ican radio has created, is the great body of expert technicians. The Naval Communication Reserve and the Signal Corps Reserve are proud of the proportion of men they have who are employed in the radio industry or are outstanding licensed amateurs.

The latest FCC report shows 46,850 licensed radio amateurs in the United States—amateurs whose ability and response to civic duty have become traditional in storm, fire, and high water.

THE Navy, working closely with civilian operators, estimates that in a national disaster it could mobilize a network of 2500 amateur stations within two hours. The Army enlarges its contact through the Army-Amateur Radio System, which includes 1394 operators selected for proficiency. Supervision is exercised by the Chief Signal Officer. Membership is by invitation, without physical examination, pay, or gift of equipment, but with no agreement to serve in war. Members are actuated by eagerness to be ready for disaster relief work, and by their ambition to improve by weekly training in Army methods of operation.

The spirit of civilian radio technicians who are available in case of a national emergency is undoubtedly typical of many thousands of other workers in all branches of American industry.

The United States is a peace-loving nation. If the cruel necessity arises, however, I am confident that we shall be able to demonstrate that love of peace is not necessarily a military handicap. The arts of peace reach their highest perfection when directed by the private initiative of a free people. Those arts, and that initiative—if they can be quickly and efficiently mobilized—should become the most powerful support that any nation in the world is capable of putting behind its armed forces.

# As Others Would See Us

## Just as Mars, when Seen from the Earth, is Called the "Ruddy" Planet, so the Earth from Mars or Other Planets Would be Called the "Azure" Object

By HENRY NORRIS RUSSELL, Ph.D.

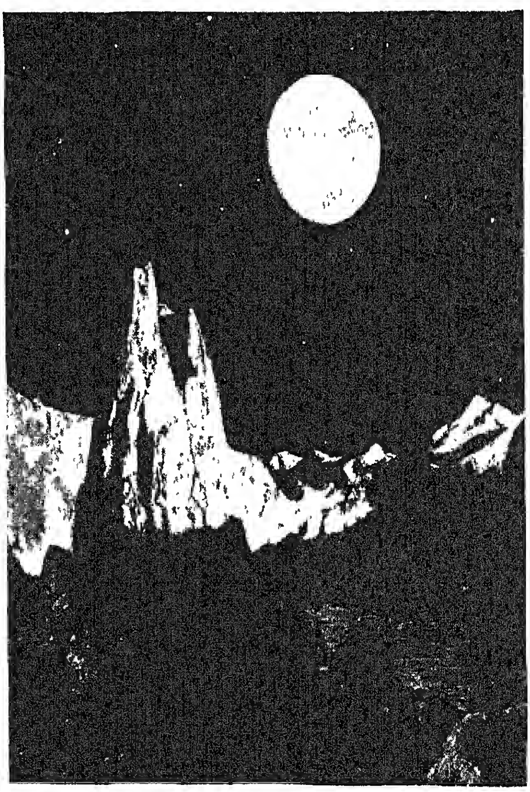
Chairman of the Department of Astronomy and Director of the Observatory at Princeton University, Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington. President of the American Astronomical Society

THOUGH there is little enough reason to suppose that any intelligent life exists on other planets of our system, yet the question how our world would look to the inhabitants of another planet remains a tempting one. Parts of the answer are very simple. It is easy to calculate just how large the earth would look, as viewed from another planet, whether it would appear like a crescent, a half- or a full moon, at any given time, and so on. But it is far from easy to figure out, on general principles, how bright it would appear. Since our atmosphere—alone among the planets—is partly cloudy and partly clear down to the surface, we might expect a reflecting power for sunlight—an albedo, as it is technically called—intermediate between the 10 or 15 percent shown by cloudless or almost cloudless bodies, such as the moon and Mars, and the 50 percent or thereabouts which is found for permanently cloudy surfaces like Jupiter's. We might expect, too, that our clouds, seen from above, would give the earth a whitish color.

We could have no hope of supplementing these theoretical estimates with the more solid evidence of observation, were it not that nature has provided us with a photometric screen, situated in exactly the right place to catch the light reflected by the earth, and send it back to us. This screen, of course, is the moon.

LONG before the earliest recorded astronomical observations, alert watchers of the skies must have noticed that the thin crescent of the new moon is attended by a faint luminosity of the rest of the disk—called in our own tongue, by old tradition, "the old moon in the new moon's arms." As soon as it was realized that the earth was a planet and, like the others, must reflect the sun's light, the origin of this faint illumination was obvious. But, for any accurate measures of this earth-light upon the moon, science has had to wait until our own times.

To measure the brightness of this light is by no means easy, for we see it through a foreground of moonlit sky, and allowance for this is hard to make. The first serious attempt is due to an American, F. W. Very, in 1911, but his observations were few and of no high accuracy. For a long series of precise observations, astronomers are indebted to a French astronomer, Dr. Danjon of the Strasbourg Observatory, who has recently published a discussion of ten years' work and established his results on a firm basis.



The earth seen from the moon, as painted by Howard Russell Butler, N. A., an artist who investigated the scientific aspects of his work. He shows equatorial clouds, a storm over the North Atlantic and a smaller one west of Africa, also clouds around the poles—the whole *not* "like a map"

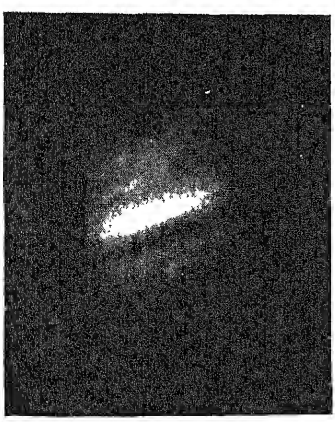
By an ingenious "cat's eye photometer" of his own design, Danjon secures images, side by side and practically touching, of the bright limb of the moon, lit by the sun, and the faint opposite limb, illuminated by the earth. Adjustment of an aperture of variable area reduces these two images to the same apparent brightness and permits the calculation of their real difference in intensity. A great advantage of this method is that the illuminated sky foreground extends over the whole field of view. So long as it is not so strong as to drown out the faint earthshine altogether, its presence makes little or no difference in the accuracy of the observations, since the image of the bright side of the moon has been reduced instrumentally to the same faintness, and the judgment of the equality of the two faint images is little disturbed by the foreground. Dr. Danjon has also obtained excellent observing conditions by taking his instruments to stations in the south of France, where the skies are notably transparent—especially when the famous wind called the *mistral* blows.

THESE observations give an accurate determination of the relative brightness of the earth-lit and sunlit edges of the moon; but a complication ensues. We are always looking at the earth-lit side right down the path of the rays which light it up; it is fully illuminated. But the sun's rays strike the surface at very different angles. At full moon, they come from behind the earth, and illuminate the moon fully, but near new moon they come, at an oblique angle, from behind the moon, and every roughness on the moon's surface, whether mountain or pebble, has its shadowed side toward us. Though the separate shadows are too small to see, they great-

ly diminish the average brightness of the surface. This effect has long been known, and its influence on the total brightness of the moon's light determined by observation. But the effect on a particular region near the moon's limb should be different for the average all over its sunlit surface. To make sure of it, Danjon constructed another ingenious photometer, with which he was able to compare directly, during the day time, the brightness of the edge of the moon with that of the sun (cut down by dark glass screens of carefully determined absorbing power).

THE effect of the shadows is very great. Even with the moon only 30 degrees from the full phase, the brightness drops to about half that at the full. At half moon, it is down to a quarter, and, for the new moon 30 degrees from the sun, to 1/15 of the value for full illumination. This helps to explain a familiar fact. The earth-shine is very conspicuous when the moon is a thin crescent, hard to see at half-moon, and visible, at phases beyond, only in a very transparent sky. Part of this effect comes from the fact that the sunlit part of the moon increases in apparent size as the phase advances, another part from the increase, just described, in its surface brightness. But, when this has been allowed for, Danjon's observations show that a large change remains.

The earth-shine at half-moon is only one third as bright as that observed when the thin crescent is 30 degrees from the sun. Extension of the observed curve to exact new moon (when, of course, no observations can be made) shows that, at this time, the earth-shine would be five times brighter than at the half-phase. The reason again is not far to seek. At new moon, the earth, seen from the moon, is at the full phase, at half moon at the half. We should naturally expect its light, reflected to the moon, to be fainter. The difference between the "geometrical expectation" of cent arises largely from oblique illumination of the earth's surface at the half phase, and partly from the effect of shadows cast by clouds, and so on. For the moon the shadow effect is so great that the half-moon is less than 1/10 as bright as the full. The earth's reflecting surface is therefore, on the average, much smoother than the moon's, but not so smooth as that of Venus, which shows a smaller phase effect.



Jupiter, taken by Gustavus Wynne Cook, with a 28½-inch reflector. Jupiter is chronically beclouded

Danjon's final conclusion is that the earth, as seen from the moon, would at the full phase send it 1/9000 part as much light as the sun itself.

From this he finds that the earth, as a whole, reflects 39 percent of the light which falls upon it. This value, as might have been expected, is intermediate between those for the cloudy and cloudless planets. These values hold good for visual light as a whole.

Observations made through glass screens of various colors show that there is less red light in the earth-shine, and more blue light, than in direct sunlight. The albedo of the earth for violet light, such as is effective photographically, appears to be 0.59 and the color index of the reflected light 0.33. This is more than half way from the color of a yellow star like the sun, to that of such a white star as Vega. In comparison with the other planets, even with Venus, the earth would therefore appear quite decidedly blue.

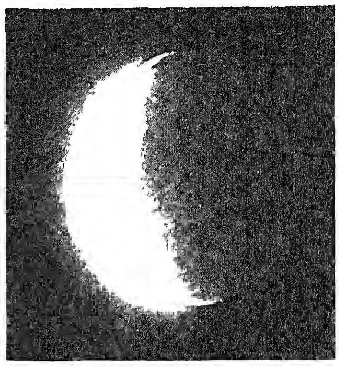
This is not surprising. The blue sky above our heads, if seen from far above the limits of the atmosphere, would look just about as bright, and as blue as it does to us. That is, the molecules of the air, which scatter blue light more than red, do so impartially, upward and downward. This is not a mere prediction of theory. All high-flying aviators are familiar with it—and the writer has not forgotten the look of the world from 14,000 feet on a clear day, with a luminous blue veil over the land, even directly below.

We might expect, too, that the brightness of the earth-light would vary from time to time according as there were more or fewer clouds on the reflecting area. Danjon has confirmed this—finding that the earth-shine is about 30 percent higher in February than in August. On certain days, when the sunlit part of the earth appeared from the moon as a thin crescent, and this region lay over the Atlantic Ocean, the reflected light was much brighter than usual—which may safely be attributed to stormy weather seen from a quarter of a million miles above the storm.

This very complete and satisfactory clearing up of an old problem makes it possible to describe the earth's appearance from the other planets with precision.

From Jupiter, for example, our planet from the sun. At elongation it would look like a star of magnitude 1.5—about equal to Castor, and almost as white. It would be hard to see after sunset—at least through an atmosphere like ours—but would be conspicuous when the sun was totally eclipsed by one of Jupiter's satellites.

From Mars the earth would be seen as we see Venus, as a morning or evening star. At elongation, it would look about as bright as Jupiter does to us, and be a conspicuous object—although it would be far inferior to Venus as we see her.



The old moon in the new moon's arms, as photographed by Harold A. Lower. The earth shine or earth-light is clearly reflected from the part not directly illuminated by the sun. The ragged edge of the terminator is caused by the sun's incidence on the lunar mountains

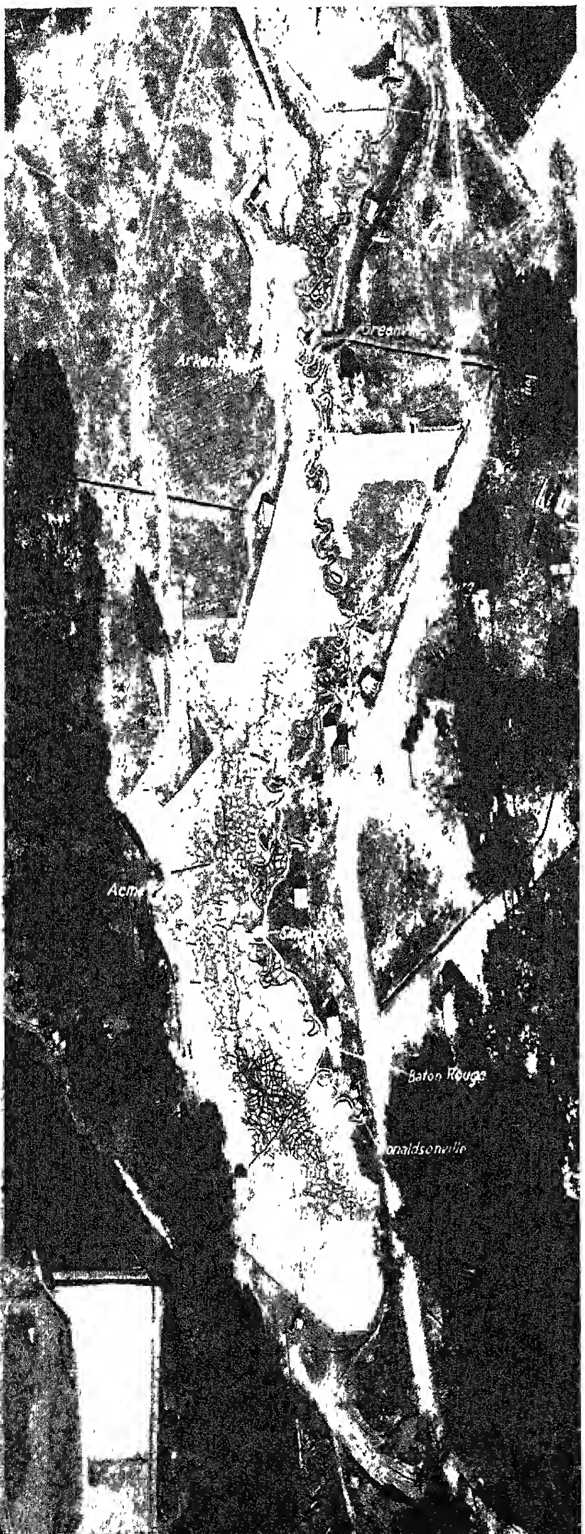
But it is from Venus that the earth would be most impressive. At opposition, it would have the apparent magnitude -6.5; that is, it would appear some six times brighter than Venus at her best does to us. No other planet in our system would be as conspicuous, seen from any other (except from a few asteroids with peculiar orbits). Moreover, the moon at the same time would appear from Venus as bright as Jupiter at his best does to us, and conspicuously yellow, while the earth would be bluish. The maximum distance separating the two bodies would be half a degree, so that they could fairly be described as a "double planet"—as Young suggested many years ago. The motion of the moon about the earth could be followed readily without telescopic aid.

AS the distance increased after opposition, the two brilliant objects would lose in brightness and draw closer together; but, even on the far side of the sun, the moon when farthest from the earth could still be seen separately by eyes like ours.

Could Copernicus—or, for that matter, Ptolemy or Thales—have had such an object lesson before his eyes, human understanding of the heavens would have advanced faster.—*Jamestown, R. I., July 20, 1937*

# RIVERS IN EXACT MINIATURE

This aerial view of the 1100-foot scale model of the Mississippi strikingly illustrates the magnitude of the project. Location of various cities on the river itself are shown on this view of the model which duplicates every curve and feature of Ol' Man River. The highways and trees help to give a size comparison of the model features




Laborers raise levees along the model river channel. These levees, constructed in concrete, are often molded in removable units for testing various alignments

DOWN in Mississippi, Army engineers are learning many things about waterways in the U. S. Waterways Experiment Station, a federal reservation near Vicksburg containing 245 acres. At this station miniature models of sections of important rivers are constructed, and studied with the purpose of determining the best flood-control measures. To date more than 170 studies of this kind have been conducted on models of such rivers as the Ohio, Missouri, Kansas, and Savannah, and several harbors and tidal estuaries. The model of the Mississippi River at this station is the largest of its kind in the world. It reproduces the entire overflow area of the alluvial plain of the Mississippi south of Helena, Arkansas, and it includes 602 miles of main river, its principal tributaries, backwater areas, and the Atchafalaya Basin, a total area of 16,000 square miles.

One of the control houses where form, height, and time of travel of flood waves are recorded. A day in nature requires only five minutes 24 seconds of research time in the model

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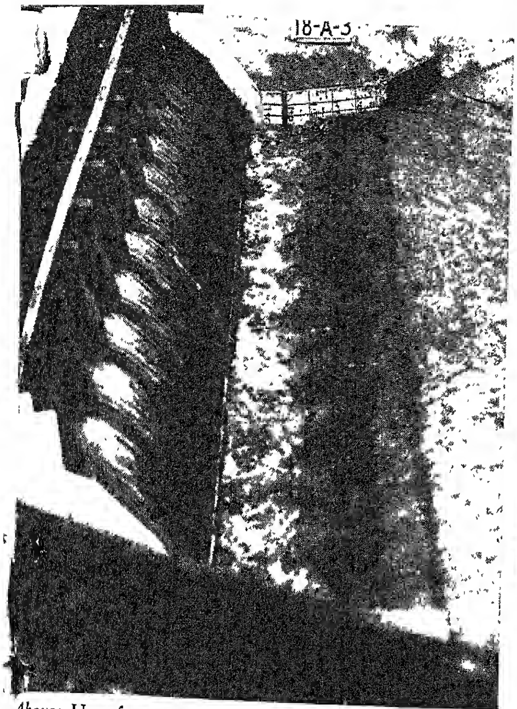
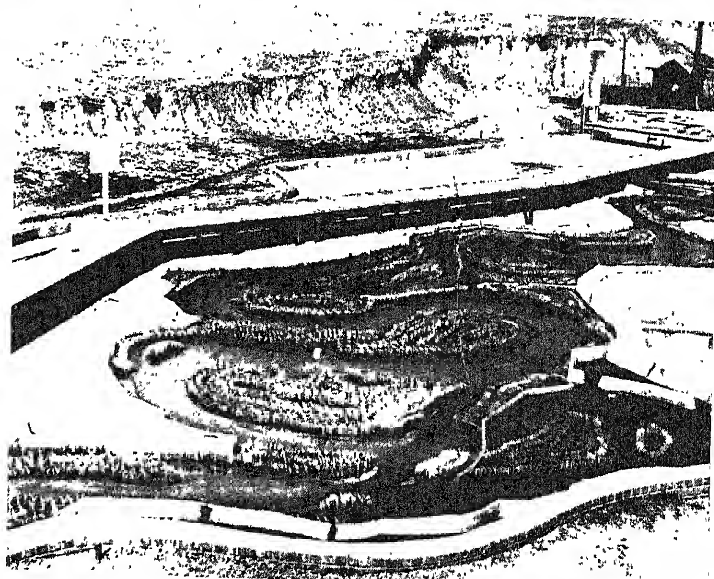


Aerial photographs courtesy U S Army Air Corps, others U. S. Army Corps of Engineers

The complete waterways station where from 200 to 400 persons are em ployed. From 20 to 25 active hydraulic model studies may be carried or simultaneously. Most of the work is done on outdoor models but much i conducted in the main laboratory building at left center of picture near lake from which water for models is pumped. It makes a compact uni

*Above:* Use of many dams and spillways on headwaters of the Mississippi may be one means of controlling floods. Hence the engineers study models of such dams and their spillways, a spillway model being shown here



*Right:* Model of a section near Greenville. Wooded areas are simulated with folded wire mesh which offers resistance to water flow like that of trees in nature

*Lower Right:* Tortuous meanderings of the Mississippi during the 1936 high water. Note shortening effected by three cut-offs constructed between curves by the Army engineers

*Below:* The Atchafalaya Basin, looking north, with the Gulf of Mexico in the foreground. This model provides the engineers with data regarding the routing of rushing flood waters through the basin

# RADIUM—

# NATURE'S ODDEST CHILD

(*In Four Parts—Part Four*)

## Its Place in Medicine... Radium Water and Death... Behind Modern Atomic Physics Lay Radium... Its Uses in Geology... Radium in Bed of the Ocean

By JOHN A. MALONEY
The Museum of Science and Industry, Chicago

THE medical profession was quick to realize the possibilities of radium rays in the treatment of cancer and fibroid tumors, tubercular glands of the neck and certain non-malignant conditions. Its place in medicine is assured, and progress in this field will keep pace with the progress made by the chemist and the physicist.

Probably no other subject has such value to the newspapers of our day as that hardy perennial, "Death Caused by Radium." Whether the story emanates from a watch dial factory, where deaths have occurred among the workers who paint the luminous figures on the dials, and who take radioactive material into their bodies by pointing their brushes with their lips and tongues; or whether the death occurs from drinking a radioactive water supposed to be a veritable fountain of youth, the amount of public reaction measured in increased circulation for the newspaper makes such a story well loved by the sensation-seeking kind of editor. It is invariably followed by many letters-to-the-editor, written by cranks on both sides of the argument, and these are each time well aired in the public forum until interest begins to lag and the whole case is forgotten. Industry has apparently learned its lesson and helpless women are no longer being allowed to ingest poisonous material in watch dial factories and then spend a few horrible years awaiting sure death.

RECENTLY a well known business executive died and the newspaper reports of his death carried the statement that he had been drinking "radium water" sold in bottles as a commercial product. The daily press immediately swung into action and was followed closely by the "popular" scientific magazines. Invariably the editors will ask medical men for expressions of opinion, and just as invariably the answers will contradict each other. The editors do not realize that the average medical practitioner knows very little about radium.

Since the number of manufacturers offering water, which has supposedly been treated with radium, for sale to the public will increase in direct proportion to the unfortunates who will ever seek a fountain of youth, or until the government prohibits its manufacture and sale, it may be well to state the truth about quack radium devices in the light of common sense and in the opinion of men who have lived their lives with radium. Radium contains one of the most powerful energies known to man, hence it can be either an agent for great good when it is harnessed by the hands of competent specialists, or an agent for awful destruction in the hands of the ignorant.

Photo Associated Screen News, for Eldorado Gold Mines

**Barium-radium crystals in a pail, one step in the long process of reducing the extraneous content**

Any substance known to contain radium should not be taken into the body through the digestive tract, since it will induce necrosis, or death, of the tissues with which it comes in contact. In treating a patient with radium the physician never allows the radium to come in contact with the tissues, but introduces tubes filled with radium or radon (radium emanation) into the area to be treated and withdraws the tube after a predetermined interval of time.

It is now well known that a part of the dials for watches and other gages, bottled elixirs and the so-called "radium" pads have been treated, not with radium but with the cheaper mesothorium. With radium selling in the world market at somewhere in the vicinity of 30,000 dollars a gram, it can scarcely be expected that the modern descendant of the snake-oil salesman would forego the possibility of doing a little "cutting" and use a less expensive substance than radium. Sometimes, however, good, wholesome, unadulterated tap water has been sold to a gullible public, adorned with a label that explains in great detail its marvelous powers as a remedy for everything from falling hair to falling arches. To the addict who feels that he must have his radium highball or cocktail, let the simple statement suffice that all of the bottled preparations of this kind on the market are either as harmless and ineffectual as ordinary water or else they are highly injurious and dangerous to life itself. There are, however, many excellent natural springs in the world where water that has been irradiated by nature is available. The "radio-pad" is about as energetic as the ordinary watch dial; the fact that these pads shine in the dark is no assurance that they will cure ailments and it is a waste of money to buy them in hope that they will be beneficial. As in the case of the water, if they were strong enough in their radioactivity to affect the body, they would also be strong enough to do untold damage. Beware, therefore, of patented radium preparations, for they fail on every count.

Radium has played a very important rôle in medicine but its influence in changing the course of physics directly, and chemistry indirectly, has been all-important. Viewed with the naked eye, radium is not singular in its appearance, but its radioactivity would have become apparent sooner or later from its effects if the photographic plate incident had not led Becquerel to set Marie Curie to the task of tracing its family tree. So little was known of this new energy source that its action became known as "rays" and, just as Roentgen had called his discovery X rays, so the emanations of radium were temporarily to be known

as "alpha," "beta," and "gamma" rays respectively, to distinguish them. Popular usage, rather than logic, often determines such matters and these terms have become so widely used that scientists have never attempted to change them, although subsequent investigation proved that only "gamma" was a ray in the sense that light is spoken of as a ray, and that it alone, of the radium emanations, has a place in the spectrum. The so-called "alpha" and "beta" rays are in reality charged particles.

Science Service photo

**Dr. L. F. Curtiss demonstrating a pair of new forceps used at the National Bureau of Standards for handling radium. Dr. Curtiss designed the forceps, which keep the hands as far removed from the radium as possible, thus preventing injuries**

The "gamma" ray of radium is quite similar to the "X ray" of the cathode-ray tube. Rays of this kind have strange powers. They have been turned on fruit flies and have caused monstrosities to result from their propagation. They have caused grapefruit to flower in five weeks instead of five years. The biologist is beginning to apply the experiments of the physicist and, where the latter batters away at the nucleus of the atom to tear it apart and learn its secrets, the former bombards the genes of living tissue and secures another kind of transmutation. These two sciences have gone on divergent paths, but it is interesting to see that this odd child of nature, radioactivity, may yet bring them together in a common cause.

TALK to a physicist about radioactivity and in a few minutes he will have you talking about atoms, nuclei, electrons, protons, neutrons, and deuterons. To the layman all of this business about atoms sometimes seems most bewildering and he is tempted to give up in despair. It may be well to remember that, until the discovery of radium, the physicist knew about as much concerning the nature of the atom as our friend Democritus, who takes the credit for propounding the atomic theory in the 5th Century B.C. Dalton revived the atomic theory, which had lain dormant for centuries, but his explanations, given at the beginning of the 19th Century, are scarcely recognizable today.

The members of the family of radioactive elements are not social climbers, but rather the opposite. They are constantly degenerating into lower strata of their society and in this act of degenerating they give off energy. Alpha, the first type of energy which is given off, is an atom and, while it is not actually seen in its flight through space, it has been made to tell its story by landing on a substance which scintillates as a result of the impact. Beta, in turn, is an electron—a negatively charged particle which travels at about the speed of light. A thin sheet of paper will stop the alpha particle dead in its tracks, where it gives up the ghost by the simple procedure of turning into helium gas. It takes a few sheets of paper to stop beta. Gamma, which is a true ray, will penetrate solid material in much the same manner as the X ray.

C. T. R. Wilson, an eminent British physicist, was the inventor of an ingenious device, known as the Wilson cloud chamber, which made it possible to study these emanations with comparative ease. Its operation depends upon fundamental principles contained in every high school textbook of physics. Push a piston into a cylinder and you compress the air and heat it at the same time. Wilson reversed this procedure and devised a glass cylinder with a piston that can be pulled out so quickly that a fog of water vapor enshrouds the tell-tale footprints of the rays dashing across the chamber.

The historian of the next century will write more about our wars on the atom than about our wars with our fellow men. Scarcely an issue of periodicals devoted to science today appears without some news of progress in "bombarding the atom." The poor atom has been set up as a target and the heavy artillery of radiation from a radioactive material or from an artificial generator of radiation begins to hurl projectiles at the nucleus of the atom in an effort to tear it apart. Announcement follows announcement from the physical laboratories of the world, and a friendly race is constantly being run to see who can first succeed in breaking down the last-line trenches of matter itself. A few years ago some scientists predicted that when man succeeded in blowing the atom to bits he would wreck the world. Today nearly all physicists believe that man will never wrest enough atomic energy in this way to keep the whistle of a peanut wagon in operation. Consider that the gunners in this artillery regiment have about only one chance in 10,000,000 of hitting their target and you see why it has taken years to chip off even the outer layers of the atom.

The modern atom dates from Dalton's conception of its nature—a conception that was eminently satisfactory until the year 1897. Since then, styles in atoms have changed with almost the fickle rapidity of Paris fashions. The Dalton atom was altogether too simple to explain radioactivity, X rays, and similar phenomena. Sir Ernest Rutherford proposed the now famous "solar system atom," in which a nucleus is surrounded by revolving electrons, the electrons agreeing with the numerical equivalent of any given element in the table of the elements prepared by Dmitri Ivanovich Mendeléev. (It's a small world, for here we meet this great Russian again, having left him in Part I as he watched Marie Curie in the laboratory. Little did he dream that this blushing girl whom he had complimented was to play such an important part in proving his own theories about the elements.)

The Rutherford atom did very well, also, until the meddling mathematician began to put it to the test that is always the final word in science—the test of measurement. Measurement determines our progress. Lord Kelvin and many other great minds have pointed out that we always make an advance when the mathematician has pushed forward one decimal place. Look over the history of modern science and the truth of that statement will be more forcibly impressed as you turn each page. And so, when the mathematicians proved that electrons, as they revolved, radiated energy and therefore should, in the natural course of events, fall into the nucleus, things began to look bad for Dalton, Rutherford and Company. The universe should have collapsed as soon as it was born, it seemed. But the atom has ever had its own staunch crusaders and Niels Bohr, a Danish pupil of Rutherford's, and, like him, a Nobel prize winner, applied the quantum theory of Max Planck to the Rutherford atom and saved the day. Bohr made the electrons jump from one orbit to another, emitting radiation as they did so. This was the first

attempt made by science to explain why light is emitted by atoms in the sun or in a lamp filament, and for that reason alone the Bohr atom was very popular among physicists. Sommerfeld gave elliptical orbits to the Bohr atom and made a few minor changes in its features. At this stage physicist after physicist took hold of the atom and each gave it a new property. The process is still going on, each new foster father leaving to his atomic brain-child a heritage of greater value than his predecessor.

UP to this point this atom business is not very complicated, but it just seems that you cannot let anyone with a flare for mathematics alone with anything very long and come back expecting to find it as simple as it was when you left. The handy man can put two boards together and make a gadget, but the mathematician will start with two theoretical boards on a drafting table, and when he is finished he may have a gadget—but he will have a mathematical treatise about it in addition. And so it was with the atom. Mathematics, in the person of de Broglie, decided that the atom was much too simple and remedied this evil by proving that the electrons were accompanied by waves, and that, although these electrons might well be infinitesimal bits of something or other, they behave as if they were mere wraiths. Thus was born a new branch of physical science known as "wave mechanics"—a branch at once a mathematical paradise for the scientist and the utter despair to the layman. Next comes an Austrian physicist, Schrödinger by name, who improved on de Broglie. He decided that, if the atom seemed to be composed partly of electrons and partly of waves, it might be well to dispose of the electrons and keep the waves. His atom became a nucleus surrounded by a kind of electrical halo—a diffused cloud that completely obliterated the old solar system atom of Rutherford.

The plot continues to thicken with the advent of Heisenberg, a brilliant young mathematical physicist of Germany, upon the cosmic stage. He restored the electron to some of its old glory and declared that the mystery consisted in not being able to determine where the electron was located at any particular time. Its presence could be detected only when it was disturbed, but by the time it is disturbed it is no longer in the same place, so that you cannot identify it from one moment to the next. It was but a step from this conclusion to the conclusion that science would proceed along less stony paths by considering the atom as a statistical average of electrons. In a word, the mathematicians had won the day, leaving the more philosophical scientists to sit back in amazement and murmur, "'Tis a strange world, my masters!" The more we learn the less we know.

Admittedly this is a rather superficial and brief narration of man's attempt to wreck the atom. However, it has a place in this discussion because, until very recently, it was hoped that radium would serve as the dynamite which would blow the atom apart. But the physicist has found it a stubborn tool. Powerless to aim it at a target, he has had to trust to luck, with only varying degrees of success. The time was coming when he could lay aside this unwieldy weapon and substitute for it a man-made bombardment of high-voltage electricity. The nucleus of the atom is walled in by what the scientist calls a "high potential," and only a higher potential can penetrate that wall. Today huge machines have been built with which protons can be shot at atoms at pressures as high as 15,000,000 volts. Some of these electric guns consist of two huge metal spheres in which the experimenters sit, safe from harm. Static electricity is built up in a reservoir about one sphere and when it can hold no more it spills over into the other sphere in a terrific flash of artificial lightning which is directed against the atom. Another apparatus, the cyclotron, has been still more widely used in the bombardment of the atom. All of these works of man came about through the discovery of radium.

A visitor at the Port Hope, Ontario, plant of the Eldorado Gold Mines, inspecting one of the final stages in the refining of radium

The physicist is by no means the only member of the scientific family who has taken a keen interest in this odd stuff called radium. The geologist, too, finds radium helpful in arriving at the solution of some of his problems. First of all, the emission of alpha particles which immediately turn into helium gas has afforded the geologist a rather accurate time-clock for measuring the age of rocks and hence of the earth itself. Minute amounts of helium gas are captured from the disintegration of radium within a rock. The geologist measures this helium and thus computes the time required for its generation from the radioactive material which gave birth to it, and so arrives at a conclusion about the age of the rock itself. It was by this method that Lord Rayleigh determined the age of many rocks and was able to place a lower limit on the age of the earth as not less than 400,000,000 years. This conclusion, in turn, gave the biologist a wider latitude in explaining some of the seeming discrepancies in evolution. The generally accepted figure for the earth's age is now about 2,000,000,000 years.

Again, the discovery of radium has raised another interesting question in geology; namely, what effect does the heat generated by radium have on the interior of the earth? We have recently constructed at the Museum of Science and Industry in Chicago a device known as a pressure box, which is descended from an invention of Professor Bailey Willis, an eminent American geologist now at Stanford University in California. Two steel pistons representing horizontal pressures within the earth, when squeezed together, cause vari-colored layers of wax, representing the various strata within the earth, to simulate in a very realistic manner the folding and faulting of igneous rocks, the formation of mountains and valleys and other phenomena—all in a few seconds—which actually take thousands of years to occur in the earth itself. This same Bailey Willis has done much to bring the problem of the effect of radioactivity on the heat of the earth out of the realm of contradictory theory and conjecture, and to prepare it for the findings that must inevitably come as man's knowledge of the nature and origin of radioactive substances increases.

THERE is a group of American geologists who are devoting much of their lives to furthering our knowledge of this problem, by examining radioactive deposits over the entire earth, laboriously collecting small samples. This is a problem that is integrally connected with the phenomenon of radioactivity. Like the pioneers of the history of radium itself, these men are not satisfied to take the path of least resistance. The romance of radium is not a thing of the past. Our knowledge of this curious substance is still in its infancy and the men who are advancing that knowledge are encountering as many difficulties as those which faced the others. Consider for a moment the work that is being done by such men as Dr. Charles Snowden Piggott of the Geophysical Laboratory of the Carnegie Institution of Washington. We have noted previously that radium occurs throughout the earth's crust and probably throughout its interior as

well. Dr. Piggott has examined countless samples of rocks from the eastern coast of North America, from Georgia to Greenland.

Dr. Piggott has found that Stone Mountain in Georgia, for example, projects a mass of rock above the earth which weighs about 500,000,000 tons, and that in this mass there are about 1727 grams of radium. Since radium gives off about 100 calories of heat per gram each hour, the amount of heat that is being generated within Stone Mountain is about 172,780 calories every hour. If the interior of that rock were strung with electric light bulbs, it would take about 3000 of them to generate the same amount of heat per hour as is being generated day in and day out, now and for centuries to come, by the radium in that rock. For the statistician who delights in such figures, Dr. Piggott estimates that a block of granite the size of the Woolworth Building in New York would contain about 15 grams of radium and the pyramid of Cheops about 22 grams.

PERHAPS of more interest to the layman is the work that Dr. Piggott and others have done in determining the radium content of the floor of the ocean. Few such measurements have been made, and only the most general conclusions have been reached about the why and how of these radium deposits. In striking contrast to the ordinary rocks of the earth's surface, the samples from the ocean bed reveal an extraordinarily high concentration of radium—the latter being about ten times as active as the former. One sample was separated by suspension in distilled water and the part which settled to the bottom consisted of coarse skeletal remains, small clay balls resembling excreta, and specks resembling finely ground pepper. Other samples resembled tree rings, with clay separating the deposits of manganese. Just how these ocean sediments acquire their radioactive properties has been the subject of much discussion. The suggestion was first made that the innumerable living organisms which inhabit the sea extract the salts of uranium from the sea water, store them in their tiny skeletons and take them to Davy Jones' locker when death removes them from circulation. To show that this theory is untenable—plausible though it appears on first inspection—Dr. Piggott quotes the findings of Bischof, that an oyster requires the lime from 76,000 times its own weight of sea water, and if the uranium salts from this great quantity of water were stored in the skeleton shell of the oyster, the amount of radioactivity would have to be much more than it actually is. Again, if these skeletons were responsible for radium deposits, other types of sediment on the ocean floor would be free from radioactivity. Yet the red clays, which are largely mineral in their composition, are even more radioactive.

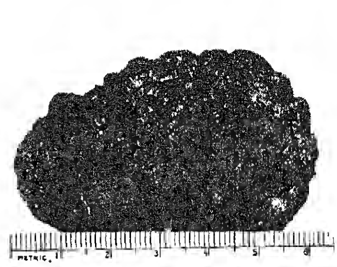
Trace the uranium in sea water back far enough and you will find that it leads you to igneous rocks on the land. The rocks give forth uranium to the water in a form of colloidal solution and, by some mysterious process, it collects in the sediments of the ocean in a form more highly concentrated than in the original rocks from which it sprang. The theory that radium is deposited in the sea by being washed down from the earth's crust and forming what the geologist calls detrital accumulations has also proved untenable, for the nearer one comes to the shore the less radium concentration is apparent, the activity falling off to a point about equal to that of the surface rocks on the shore. Another explanation which has been put forward to show the manner in which this radium gets into these sediments is that it results from a volcanic and hydrolytic action at the point where the molten rock and sea water meet.

Dr. Piggott believes that none of these explanations will prove correct and offers one that, while it must be regarded as theoretical until man bestirs himself to the extent that a representative number of samples of cores can be gathered from the ocean beds and sufficient money and time can be expended for a more thorough examination, certainly has merit as a logical explanation. In a paper which he published in the *American Journal of Science*, he said:

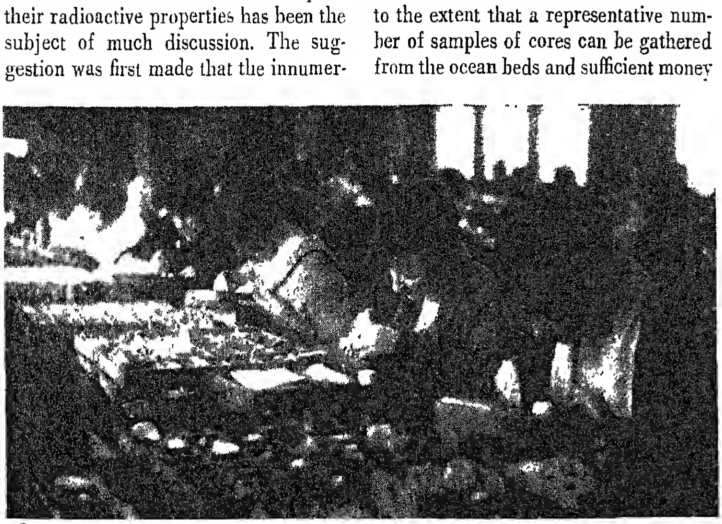
"There are probably several factors aiding in its (uranium's) separation and concentration in those places where it is found to be most abundant. Skeletal remains may take down some; also dust particles of volcanic or other origin absorb some and sweep it to the bottom; but probably the greater proportion comes out as a result of oxidation. Water which is near enough to continents or shallow enough to have sufficient organic material at the bottom to maintain a slightly reducing environment tends to keep its uranium in solution, whereas the very deep bottom waters, far from land, do not contain organic material either washed from the land or as undestroyed organisms. Consequently, they afford an oxidizing environment. That these waters are oxidizing is borne out by the direct measurements of the oxygen content with depth made by the *Carnegie* . . . . . . . . . . This shows that the environment at the bottom of the ocean is of an oxidizing rather than a reducing nature. In the deeper parts of the ocean where there is little movement, the water at the bottom must be at saturation with respect to the oxides of uranium. There is, therefore, a tendency for them to separate out just as iron and manganese do. Volcanic dust, detrital material, and skeletons of organisms modify the possible concentration by diluting it."

Of all of the 28 samples of ocean sediment which have been examined, 27 have come from the Pacific Ocean. Perhaps tests in the future from the other seas where vulcanism does not run rampant, as it does in the Pacific, may reveal the truth of these conclusions. At all events, man may yet find it more economical to secure his radium from the denizens of the deep than from the deposits which are nearer at hand. Will he dredge the deeps for precious bits of that odd stuff called radium? Who knows? Strange things have happened since radium was discovered. Things stranger still would not be quite unexpected.

(The End)



A magnesium nodule taken from the ocean floor. After it was sawn in two, the sawdust contained one part in 12,000,000,000,000 of radium



©Radium Luminous Materials

**An old photograph, showing girl painters applying radium luminous material**

# For Floodless Stores

## Bulkheads for Stores in Flood Districts . . . Prevent Damage to Valuable Stock . . . Made of Aluminum . . . Swung on Trolleys . . . Quickly Placed

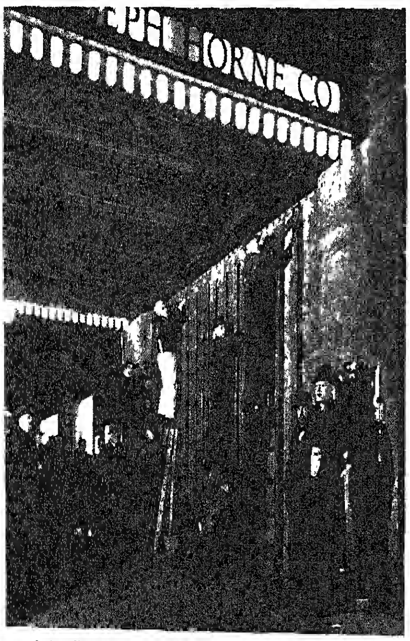
By R. T. GRIEBLING

THE success of any proposal to safeguard large buildings from the ravages of flood waters is assured if it can answer one question affirmatively:

Will it work?

This is the question which bothered Pittsburghers considerably after the St. Patrick's Day flood of 1936. Those who were interested in protecting their buildings from future flood disaster didn't quite know how to go about it. They were familiar with the plans that *didn't* work; now they wanted something better. Whatever that scheme was, it had to be decided upon quickly, because the city records show that past floods have descended upon the Golden Triangle in every month of the year except October.

Such reasoning was wise, for less than 10 months later the city saw a flood crest of 34.5 feet, and only last April damage to the extent of more than 10,000,000 dollars was done by rivers which rose to 35.1 feet. But quite a number of business concerns were ready.



The Horne flood emergency brigade had a chance to go into action this year. Bolting down the main entrance door bulkheads

The most obvious thing to do in case of a flood is to place valuables out of reach, either by moving them to a different location or by keeping them at such a height that they are indubitably safe. Since relocation of a city the size of Pittsburgh is out of the question because of prohibitive cost, the next best thing to do was to place the city on stilts wherever possible.

The Farmers Deposit National Bank and the Pitt National Bank took to stilts, the former by constructing a new 300,000-dollar vault on the second floor, 14 feet above the water's 1936 crest; the latter by relocating its vault on the first floor. The old vaults had been in the banks' basements.

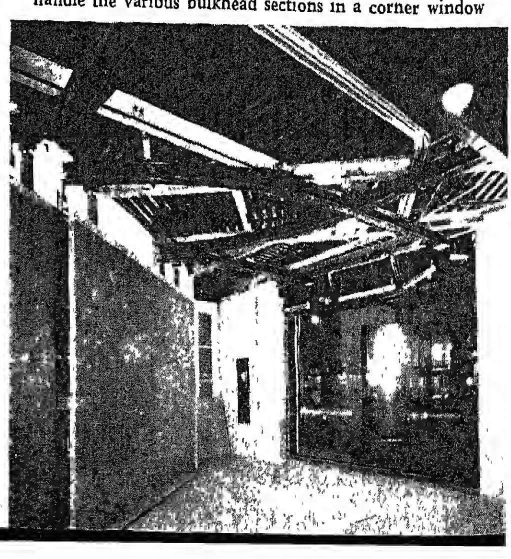
The Weirton Steel Company built a new boiler house higher than the highest stage of water experienced previously, and the correspondence and blue print files of the Westinghouse Electric and Manufacturing Company were moved from the basement to the upper floors. Other concerns took similar measures.

A LEAF was next taken from the book of Portsmouth, Ohio. That city's concrete flood wall has held back much high water, even though it was inadequate last January. The Pennsylvania Railroad built a number of retaining walls along its right-of-way on the Conemaugh River near Johnstown; the West Penn Power Company erected a 215-foot concrete barrier to protect its Springdale plant; and the Aluminum Company of America spent 400,000 dollars for a sea wall 1787-feet long in order to shield its New Kensington works.

But what plan should be adopted when measures such as these are not practical? What, for example, should a department store do—an establishment which depends on its ground floor for its principal display space? It would be folly to

As seen from the street: One of the aluminum bulkheads being swung into place in a window on overhead trolleys

The intricate system of trolley tracks that had to be built to handle the various bulkhead sections in a corner window



abandon this floor and to confine business to the upper stories. Similarly, it would be madness to surround the building with a 10-foot sea wall and thus to exclude the show windows from the view of pedestrians.

The Joseph Horne Company solved this problem in a most satisfactory manner. It devised a way by which the store could be made watertight for a sufficient length of time to enable employes to move all merchandise and fixtures from the basement and first floor to the upper stories. The care with which the Horne plan was conceived and executed prompted the Bell Telephone Company and the Duquesne Light Company to follow suit.

Horne executives are pre-eminently qualified to discuss floods. This large department store has been at its present location in the Golden Triangle for 43 years, and was one of the worst sufferers in the 1907 flood, when the water reached a height of 30 inches on the building's outside walls. Last year the water climbed 91 inches higher. After the 1907 flood, the executives were determined never to suffer such damage again. They ordered the construction of huge steel panels which were to be fitted into windows and doors at the next threat of flood. Calking would make them waterproof, and an elaborate pump and sump system in the sub-basement would take care of seepage.

When these panels were built, two errors in judgment were made, but no one knew about them for 29 years. It took the St. Patrick's Day flood to point them out.

The first concerned the panels, or bulkheads as they are called in engineering parlance. These were stored in the Horne warehouse across the river. When they were finally ordered out, the water was rising so fast that they could not all be brought across in time. Because of this fact, panels that had been erected were perfectly useless.

The second error lay in making the weight of each bulkhead so great that a crew of no less than 15 to 20 men was needed to handle it. Speed of erection was out of the question.

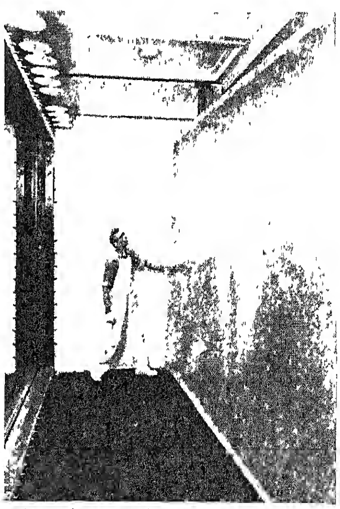
While the idea of having bulkheads was basically sound, the inefficiency of the old bulkheads was amply demonstrated. Horne executives felt that if new ones were to be built, they must be without their predecessors' shortcomings. For one thing, there was to be no more of this business of storing bulkheads in the warehouse and then having the river cover the bridge approaches. The new bulkheads were to be "on location." Secondly, they should be constructed in such a manner that they could be easily handled.

TO C. B. Shea, a Horne vice president, goes the credit for first suggesting the ingenious manner in which the bulkheads were finally built. He suggested the hanging of movable partitions at the rear of the show windows, concealed by show window paneling. In time of danger, the paneling would be taken down and the bulkheads rolled forward on trolley tracks toward the windows, where they could be securely bolted down. Small openings between window glass and bulkheads would allow the water to rise inside the space so that outside water pressure would not crush the glass.

In order to lighten their weight as much as possible, the bulkheads were made of aluminum. Only two men are needed to swing each window bulkhead forward smoothly and easily. The entrance door bulkheads are made in sections, each of which can be handled with speed. A crew has been trained to erect the bulkheads in the shortest possible time. A chance to watch the procedure was given to passing Pittsburghers last January, when the Allegheny River, along the left bank of which the store is situated, almost came into the store through the first floor entrances. The bulkheads were in place in short order.

The idea of using flood bulkheads is not new, for most buildings in downtown Pittsburgh have emergency sets, made of some material or other. The real contribution to flood bulkhead architecture and engineering is their fabrication from a light metal. The idea appealed so well to engineers of the Bell Telephone Company that they decided to use aluminum for the bulkheads of the Sterling exchange, where eight feet of water last year succeeded in crippling the branch for months. These bulkheads were not ready for the January flood, but luckily they were not needed, either then or last April. A similar application was made at the 13th Street substation of the Duquesne Light Company, which suffered heavy flood losses last year.

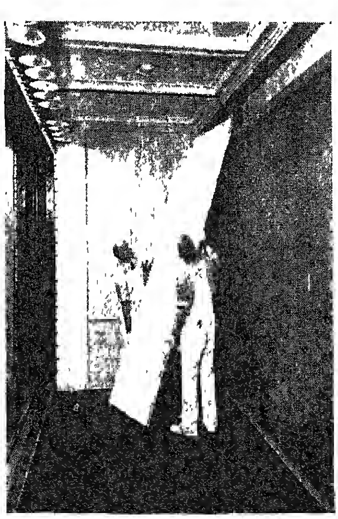
Still another kind of bulkhead is the stationary one, such as the special windows which were installed on the first floor of the *Pittsburgh Press*. These were made of steel, concrete, and thick glass, strong enough to resist the tremendous hydrostatic pressure of a flood.



Photographs Courtesy Aluminum Co. of America

**With all obstructions removed, the light metal panel is swung forward**

**Removing the merchandise from a**



**Decorative paneling, normally secured by dowels, is then taken down**

**With socket wrenches, a trained crew bolts bulkheads into position**

# THE MYSTERY OF THE

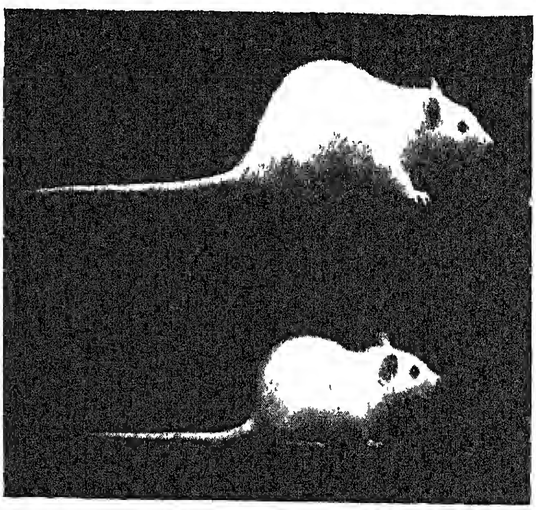
## Why Must Man Have Fifteen Chemical Elements, but Does not Utilize the Other Seventy-seven? Secrets that Nature has Thus Far Withheld from Us

ARSENIC, though highly poisonous to most forms of life, is food for some microbes. Other microbes eat selenium, an element with which the soil sometimes plays Borgia. Thus, quite recently, the selenium present in shale lands of Wyoming and the Dakotas has been shown to be slowly poisoning domestic animals and, in some instances, human beings, causing stunted growth and premature aging. Wheat from this region bears its toxic selenium into other parts of the country.

Here, therefore, are two elements which contribute to the vitality of some live beings and to the early death of others. Indeed, it is one of the great mysteries of bio-science why a living mechanism can use only certain elements, and finds either useless or toxic the rest of the ninety-odd known to chemists. Even an element very closely related chemically to one of the life elements cannot replace it in the architecture or in the bio-chemical activities of a given creature. Iron, indispensable to man's blood, cannot be replaced by the chemically very similar nickel—which is discovered in vital tissues only every now and then, seemingly as a chance ingredient. Perhaps more strangely, a life activity may be undertaken by one element in one organism and by another life element in another organism. For example, in many lower forms, such as lobsters, copper plays the same rôle as iron in human blood; that is, it forms part of a respiratory substance which transports oxygen from the breathing organs to the cells.

IT is remarkable, too, that by sheer chance or by grand design, the abundance of the different elements on the earth's surface is extraordinarily close to the ideal distribution for life's needs. The composition of man is strikingly like that of the waters and the soil out of which he has emerged. The saltness of seawater is so like the saltness of blood that the solutions best adapted for keeping tissues alive in the laboratory are, in every case, but modified seawater. In a real sense, the fluid from an ancient ocean flows through our veins.

Could life have originated on the earth if the distribution of the elements had been far different? Could living creatures have fashioned themselves largely out of arsenic and selenium, for example, instead of phosphorus and sulfur? These are questions which biologists today despair of answering: the secrets of the relationship of the elements to the construction of life's uncountable varieties remain altogether obscure.



Rats used in experiments at the Bureau of Home Economics of the United States Department of Agriculture. Upper rat received adequate phosphorus; lower rat, low phosphorus diet

Much valuable scientific knowledge, however, is steadily being accumulated concerning the life elements in the chemistry of man. These discoveries have come out of the extensive and highly refined researches of nutritional science, and out of the application, to man, of the findings made with domestic and laboratory animals.

Such knowledge has been eminently practical. Goiter, endemic over vast regions, including important sections of this country, is much less common—because the element iodine is being added to water supplies, or to table salt. Once, it was accepted that a mother, at the time of childbirth, must probably lose a tooth or two, and that her child might helplessly be deformed by rickets. Now, thanks to the influence of the newer science of nutrition, the chances are that both obtain adequate calcium and phosphorus, and under the proper conditions for the healthy assimilation of these life elements.

Also, thanks again to nutritional science and its practical use, our population has been able to endure, with an amazing minimum of deficiency diseases, the recent years of economic stress. A balanced diet, with suitable proportions of the life elements and their compounds, had become popular. Thus diminished means were put to increased advantage. Thank science for this gain.

How many chemical elements are required to make a man? At least 15, perhaps more. So, man would perish from the earth if some strange catastrophe were to make any one of at least 15 elements unavailable to his diet. African tribesmen barter cattle and even wives to get the sodium of table salt. And over a great part of interior India, the thyroid gland, overworking because of the drinking water's poverty in iodine, swells to distort the neck. Inland America knows this poverty too: iodine does not travel far from the sea. Hence, mention of such a catastrophe should not seem wholly fantastic.

Since the human body is, of course, largely water—approximately two-thirds water by weight—and since almost all of the myriads of other essential compounds contain them both, the elements hydrogen and oxygen are present in quantity.

Then, carbon and nitrogen, invaluable for their extreme tendency to form great chains and webs of atoms, must be on hand, that the living structures and the physico-chemical processes may have the molecules without whose high complexity and remarkable delicacy of reaction no life is possible. The elements sulfur and phosphorus also aid in the construction of these huge molecules, which include the proteins—such as hemoglobin, the pigment of red blood cells; casein of milk; and albumin of egg white.

The metallic elements calcium and magnesium are indispensable for the formation of bones and teeth—and, as is less commonly known, are required

# LIFE ELEMENTS

By BARCLAY MOON NEWMAN

with two other metals, sodium and potassium, for the normal activity of nerve, brain, and muscle, including the heart—and for the appropriate alkalinity and saltness of the blood and tissue fluids. In fact, these four metals constitute an intricate system of balanced antagonisms. If too much sodium is present, and insufficient calcium, the heart becomes completely relaxed—and ceases beating. If, however, calcium is suitably balanced by sodium, the heart muscle suffers the opposite extreme, that is, becomes completely contracted. Potassium acts similarly to sodium, and magnesium similarly to calcium. Nevertheless, each metal has its precise rôle. Neither is potassium entirely interchangeable with sodium, nor calcium with magnesium. All four must be supplied if the heart is to beat normally—and, in general, if any organ or tissue is to carry on its functions harmoniously.

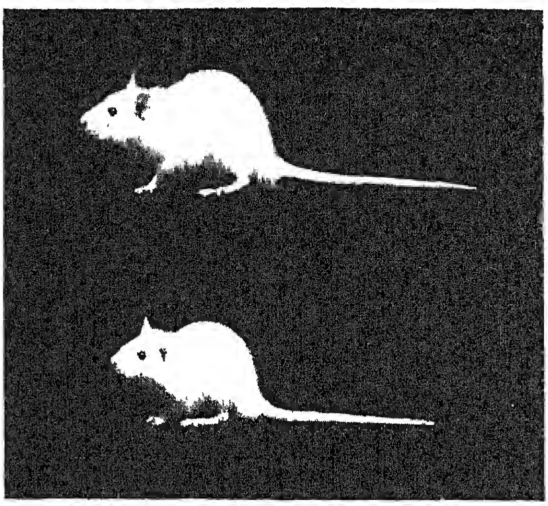
Chlorine is essential to the activity of these four metallic elements, and helps to transport them and to neutralize their electric charges and balance their effects. That is, chlorine gives rise to negative ions, or electrically charged atoms, while the metals give rise to positive ions. Furthermore, this non-metal is a part of many physiologically valuable compounds; with hydrogen, it forms the hydrochloric acid used in the stomach in the digestion of proteins.

Iron is the star of prime magnitude in the protein constellation hemoglobin, which pigment in the red corpuscles carries oxygen from the lungs to the tissues. It also is an atom of certain molecules which take part in oxidation (respiration) within the cells. And it is thought to be a necessary stimulant, or catalyst, for certain intricate bio-chemical reactions.

THESE 12 elements make up over 99 percent of the body, and the whole account of their workings in the apparently infinitely diverse and ineffably elaborate physical chemistry of life may never be set forth. None can be called more important than any other in the making of the living man, because no human life-reaction is possible unless all of them are present in proper proportion and appropriate chemical combination. These are the "Big Twelve."

The remaining three elements are needed in traces alone. And their rôles in the human physiological drama appear to be comparatively restricted. But these special, minor rôles—these apparently insignificant traces—each mean the significant difference between life and death.

Iodine is of irreplaceable value specifically in the synthesis of thyroxin by the thyroid gland. Thus, as a part of the thyroxin molecule, it assists in the regulation of metabolism, or rate of the



Other rats used in experiments at the Bureau of Home Economics in Washington. The upper animal received adequate calcium but the lower one was fed on a diet low in calcium

body's chemical reactions. When the thyroid is producing too little thyroxin, the individual has too low a rate of metabolism, hence suffers from obesity, and physical as well as mental sluggishness. Cretins are dwarfs who are remarkably benefited by the administration of adequate thyroxin.

Manganese, formerly considered merely a fortuitous though constant ingredient of the human body, has recently been proved definitely necessary in reproduction—and, as well, perhaps as a catalyst in certain chemical syntheses which occur within the cells. In the case of rats, upon which animals most of the experimentation has been done, there is a high mortality in the young born from mother rats that have been fed a diet excessively low in content of manganese.

Still more recent researches have shown that copper is, though in the minutest quantities, needed in the making of a man. This element is required to assist in the utilization of iron in the manufacture of hemoglobin. Seemingly, this explains why minute doses of copper compounds are beneficial in certain types of anemia.

Will later investigations demonstrate that the proper formation and healthy operation of the human machine, generation after generation, call for more than these 15 elements already clearly determined to be essential? We can be sure that, if other elements are discovered to be needed, they are needed only in almost immeasurably small amounts—12 elements invariably constitute all but a tiniest fraction of a man.

ANALYSES indicate that, besides these 15 bio-elements, other elements are of constant occurrence within the body. And at one time or another, according to the delicacy of the analysis, almost every one of the known chemical elements has been turned up. Exposure to the hazards of industrial poisoning makes for a host of walking reservoirs of chromium, selenium, tellurium, radium, and many other elements—which nature may not have intended man to lavish upon his system. In fact, probably any one of us could by sufficiently refined technique be found to contain at least a few atoms of every element on the chemist's list.

Cobalt is one of the elements which are invariably present, but which are thought to be adventitious impurities. Now, however, some investigators have come forward with evidence that this element must co-operate with copper and with iron in the normal manufacture of hemoglobin—and for the prevention of anemia, characterized by insufficient hemoglobin.

It is a tremendously difficult task to prepare a diet from which either copper or manganese is absent. Such is also the case with cobalt. Therefore, few persons would seem to be in danger of suffering from cobalt deficiency—should this element actually be indispensable. Of course, it would be possible, however, for cobalt to be present

in the diet, though not in a chemical form which the body could use. In addition, it is conceivable that some individuals would be unable to assimilate cobalt as it ordinarily occurs in the food, and would thus require the administration of some special combination of the element.

Zinc also seems to be characteristically a human constituent, and certain authorities point significantly to the increasing realization of the importance of this element in both plant and animal physiology. Many lower organisms make use of it—bread mold, for example.

Strangely, no analysis fails to discover arsenic, and even this violently toxic element has its proponents, however few in number. Yet, every one of even the 15 known human bio-elements is toxic in some special instance or another—such as carbon in carbon monoxide; oxygen in the form of ozone; and especially iodine, manganese, copper, in almost any one of their compounds which are absorbed in more than bare traces.

The case of fluorine is interesting. Once it was believed essential in the formation of the enamel of teeth—although this belief was based solely upon the constant occurrence of fluorine within the body. But now, the prevalence, in 300 areas of 23 states, of mottled teeth—teeth marred with ugly, permanent brown spots—has been proved to be caused by drinking water in which there is as little as one part of fluorine to 1,000,000 of water. Here we have the unusual case of an element formerly thought a life element, now shown harmful—even in quite high dilution.

THIS example serves to bring out the exceedingly great difficulty of researches into the problem of what elements are actually bio-elements but ones needed in excessively small quantity. Discoveries are derived primarily from experiments involving the rationing of animals, chiefly rats—whose nutritional requirements are very like those of man. To prepare synthetic food of definite composition and extreme chemical purity is one really mighty labor. To prevent contamination after preparation is another. Even the walls of the containers yield up impurities whose effects may be disastrous to the investigation. Glass may send forth sodium, potassium, iron, copper, zinc, and perhaps many other elements to the substance within the glass vessel—depending upon the composition of the glass and that of its contents.

Distilled water takes up atoms from the distillation apparatus itself, and from whatever the container used for storage. Contamination is therefore not only a matter of technique, but also of time. The rat cages have to be carefully constructed, of just the appropriate

Photo San-Carlo Studios, New York

**Prof. Henry C. Sherman of Columbia University, noted authority on the chemistry of foods and author of "Food Products," "The Chemistry of Food and Nutrition"**

("safe") materials for the experiments. The rats must be kept from obtaining nutrient substance from the walls of the cages—and from eating one another, or the wastes. Controls have to be maintained, for the sake of comparison, as checks upon the determinations. Finally, the laboratory animals must be bred through generations, since one generation may have a reservoir of a given element, and this supply may conceivably last a lifetime and may even be shared with the offspring. And the symptoms of deficiency may not be observable—an added difficulty—until the store of our given element has been almost entirely depleted.

Thus it is possible—though not generally accepted as probable—that some hitherto unsuspected element or elements may turn out to play an almost imperceptible part, though a life-giving, absolutely essential part, in man's vital activities. Indeed, in the case of plants, where the experimentation has been far more extensive than with animals (because it is far simpler to work with plants), elements as unfamiliar as boron have of late come to be recognized as bio-elements—irreplaceable in the nutrition of certain crop plants. Now, where plants are being experimentally grown in water culture, and where no soil is used, but instead, coarse, chemically clean sand to which the appropriate salt solutions have been added, as many as 30 different elements have been found simultaneously useful.

Photo Pictures Incorporated

**White rats kept in glass "log cabins," used by the Food and Drug Administration in experiments on the tolerance for lead arsenic in spray residues on fruits and vegetables sold in interstate commerce**

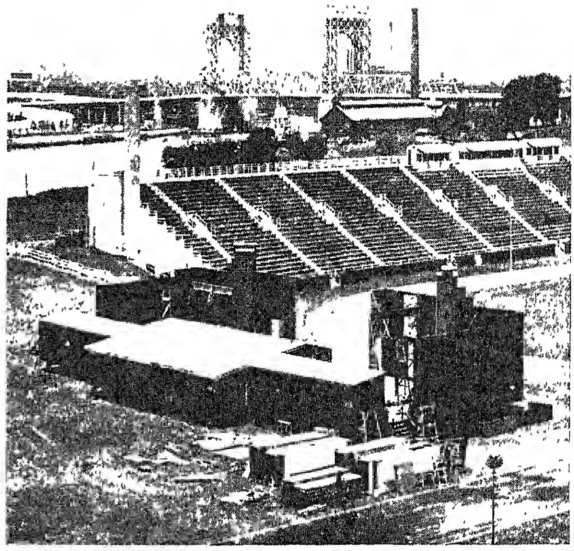
CONSEQUENTLY, we may wonder if man really gets along, with a mere 15 elements, as famously as he might with a number of additional ones. Are there stimulating elements for man as well as for the tomato plant? We must wait upon the rat, the cow, and the pig for the first experimental hints. The fascinating history of the vitamins may be repeated with the chemical elements—part of whose significance may be so slight as to be undiscoverable for generations. Meanwhile, the fact that an ordinary balanced diet contains so many elements, and the fact that it is so difficult to devise a synthetic diet "pure" of unknown "contaminations," may entirely relieve our minds as to the outcome of such research. We may be thankful also that the outcome of such delicate investigations must be afar off—for that means the indefinite postponement of what we used to hear so glibly prophesied: food pills instead of luscious steaks and tasty puddings.

Furthermore, there remains the stupendous problem of isotopes: varieties of the same chemical element, like light and heavy hydrogen. Is heavy water—water made with heavy hydrogen—poisonous? Tadpoles and other lesser organisms succumb to it. Would it be harmful or beneficial to man? What proportion of light and heavy hydrogen in his water and his food is the ideal for health? Such are the intricacies of the human physico-chemical mechanism that many people would be liable to the gravest doubts of our ever being able to answer such questions.

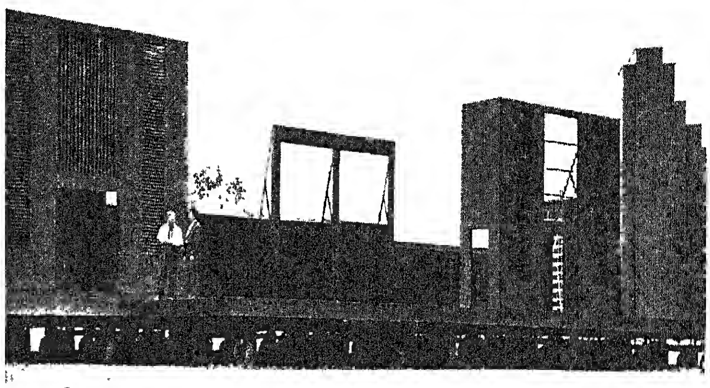
Indeed, the chemistry and physics of earthly man remain on the whole such a baffling mystery that even the biochemist most sanguinely hopeful for his young science must hesitate—unlike a number of organic chemists—before he speculates upon the chemical possibilities of liquid ammonia and ammonia vapor upon the planet Jupiter: and upon the problem of whether or not an ammono instead of an aquo chemistry has given rise to a race of ammono men, inferior or superior to our watery selves.

# A Stage on Wheels

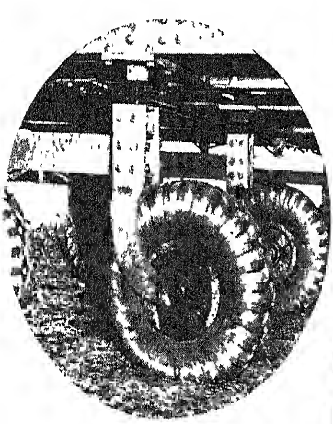
A PORTABLE stage that can be moved to the center of a baseball field, for example, used to present a play, and then moved off to the side when not in use, has been built by the New York City Department of Parks and Improvements. The stage is so constructed that it can be taken apart into 53 sections and hauled to any park or playground in the city. Fifty thousand square feet of lumber, it is reported, were required for the construction of this 150-ton stage.



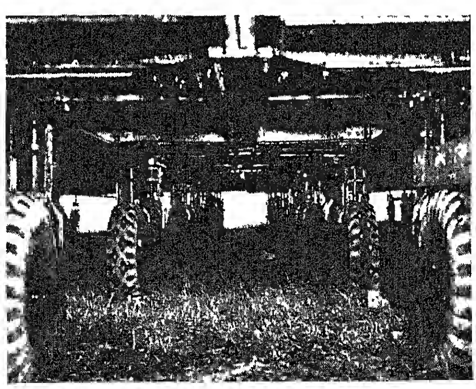
*Upper right:* A general view of the portable stage "on the sidelines" at Randall's Island after construction was completed



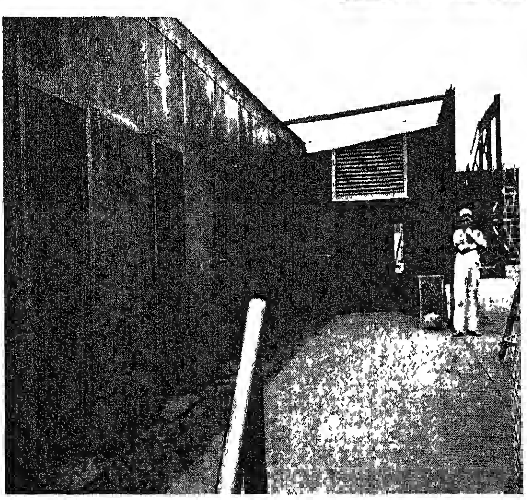
*Above:* Front of the stage. Note the wheels, which are also shown in the illustration at left, taken with the camera at ground level and pointed lengthwise of the huge stage



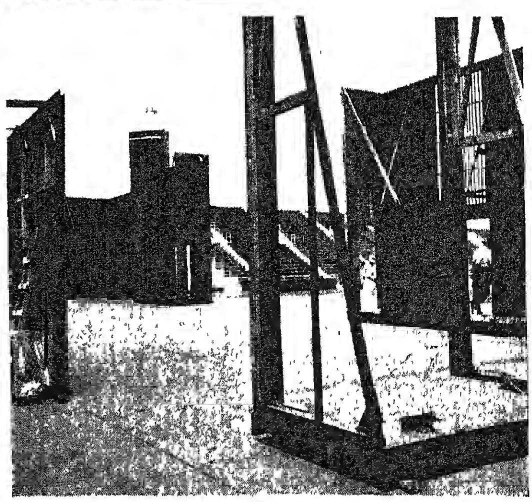
Close-up of the balloon truck tires and the leveling mechanism that makes it possible for the weight of the stage to be evenly distributed on its 224 tires



*Below:* The dressing rooms back-stage. The composition walls can readily be taken apart and assembled as necessary



*Below:* The side wings. Every part of the stage is so designed that it permits maximum flexibility and portability



# A Purgation of Purgatives

## Laxative Fallacies . . . Most Liberally Purged People on Earth . . . Autointoxication . . . Spastic Colon . . . Irrigation . . . Let Nature Set Her Normal Pace

By T. SWANN HARDING

THINGS have almost reached such a point in these United States of America that it is impossible to look anywhere without seeing an advertisement for a laxative. It is also impossible to listen to the radio more than a few minutes without being implored to attend your bowels. Much of this advertising is disgusting, yet it seems to be effective, for we are the most liberally purged people on the globe.

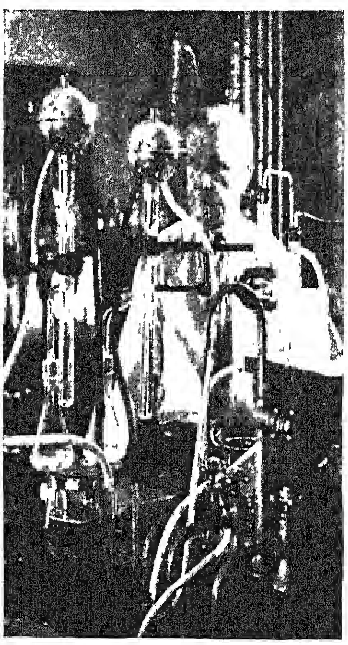
It is often stated that constipation is a relatively new complaint caused by the hurry and pressure of modern life, or by the use of too concentrated foods, or by other dietetic errors. This is to be doubted. For one thing, individuals differ enormously, as Dr. Walter C. Alvarez of Mayo Clinic has shown, in the speed with which nutriment passes through their digestive tracts—those curious tubes around which we each one live.

Many people imagine that they are constipated when they are not at all. They merely have naturally slow intestinal systems. Except for the psychic disturbance they have set up by worrying about their condition, they are absolutely all right, but they can scarcely believe this when advertisers are always dinning into them the necessity for using purgatives.

Furthermore, any who study the old Ebers Papyrus on which is written the medical lore of ancient Egypt, soon discover that constipation is not relatively new but was rampant thousands of years ago. This old record contains formula after formula for the sure cure of constipation, and castor oil enters into most of the formulas. In one case it is the sole constituent of a prescription that doubtless worked. One delightful remedy consisted of half an onion mixed with the broth of beer. It was claimed that this was not only a purgative but would infallibly dismiss all diseases from the body. It was described as "a delightful remedy against death." Today, according to some reports, there are purgatives that can more likely cause death than ward it off.

CONSIDER the coal-tar derivative, the organic substance called phenolphthalein, which is widely used as a self-administered candy or wafer cathartic. The Federal Food and Drug Administration issued a careful warning concerning the use of this drug several years ago, a warning that was repeated and further emphasized in the *Journal of the American Medical Association* (April 29, 1933).

The substance occurs in a large number of laxative preparations, many of which resemble candy, chewing gum, or wafers. Children have even mistakenly eaten these preparations in quantity and to their death. Skin eruptions and other minor symptoms from the use of phenolphthalein are common in medical literature. The drug has a legitimate place in pharmacy when properly prescribed by a physician, but its use in self medication is dangerous, especially when manufacturers urge the repeated and frequent use of their products containing it. There is no excuse for peddling candy and chewing gum laxatives among a race so addicted to cathartics anyway that they imagine that taking a purge does not constitute drugging oneself.



Analyzing remedies at the Federal Food and Drug Administration

The promiscuous use of laxatives is blamed by many physicians for our increased death rate from appendicitis and other abdominal troubles. The first thing the average person does when ill is to take a laxative, but even if the illness is a mere cold or minor infection this may be dangerous. The bowels can not be cleaned out in such manner, nor is it advisable for the patient to weaken his resistance further by purging.

Before the American Medical Association, Dr. John O. Bower of Philadelphia reported that, in a study of appendicitis patients, one in 14 died when they took one laxative; one in seven died if they took more than one laxative; but only one in 80 died when they took no laxative. The variety of laxatives these patients took was almost incredible, 37 of them being listed! About 47 percent of those who were attacked by appendicitis had taken laxatives of one sort or another. What is more, 55 physicians had actually prescribed the laxative in that many cases, and they thus lost four patients. Yet, as early as 400 B.C. the father of medicine, Hippocrates, warned doctors against giving purges in the beginning of "sharp disease" which, from his description, was probably appendicitis!

ONE of the things the advertisements teach us to dread is "intestinal toxemia." In its issue for June 22, 1935, the *Journal of the American Medical Association* said, in reply to a doctor's question: "There is no well-defined disease entity of 'intestinal toxemia' or autointoxication. Even the concept of 'biliousness', so definitely and eloquently described by our forefathers in medicine, has been abandoned."

There is no carefully controlled, reliable research work to show that the state of intestinal intoxication ever exists. All sorts of germs flourish in the bowels, and often they are the same in those in health as in those who complain of illness. Constipation rarely if ever produces chemical injury; it can not "poison" us. Even patients with infections get along better without the customary "cleanout."

Neither cathartics nor purges make the colon contents less toxic. High colonic irrigations are usually unnecessary, and may be harmful. They can not possibly render the bowel germ free. They are rarely indicated for use by careful

medical men. They can neither change the nature of the bacteria in the intestines nor sensibly reduce their numbers.

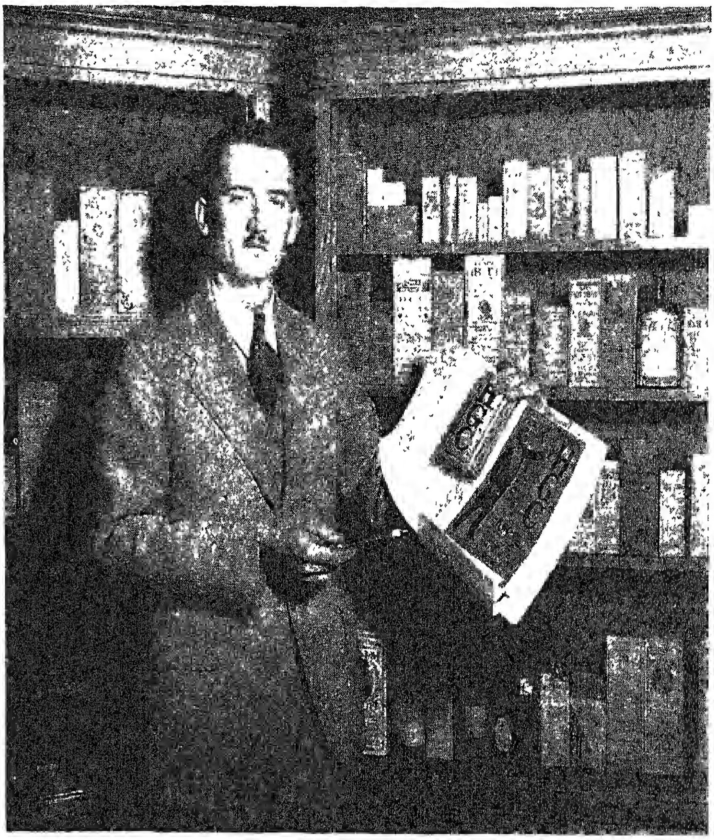
In January, 1936, Dr. Frank H. Krusen reviewed colonic irrigation for the Council of Physical Therapy of the American Medical Association, saying that unfortunately the claims of quacks and charlatans were often no more absurd than those made by regular doctors who should know better. He added that there are many opinions about such high colonics, but that they all center around the removal of toxins, clean alimentary tracts, and elimination treatments for a variety of ills. However, such irrigations often do much harm and are seldom resorted to in careful hospital practice. They often cause bad, untoward results, and but four out of 500 patients receive them in a carefully regulated hospital The famous *streptococcus* is as often contained in the feces if the person is in good health as it is in illness. Antiseptic solutions used in such irrigations are valueless and the lower bowel can not truly be sterilized. Elaborate devices used by most quacks and some others for irrigation are worthless, even though many of them have won U. S. A. patents.

What, then, of that "spastic colon" we hear so much about? There was an article on this subject in the *British Medical Journal* (April 7, 1934). Dr. Thomas Hunt then said that, whereas bowel displacements are often extreme, such organs just as often function as well as "normally" placed bowels. The bacteria in the bowel varies enormously, he pointed out, but offer no clues to assist the doctor, for the healthy have the same bugs as the ill.

NERVOUS factors are most prominent in causing the ills usually attributed to constipation, Dr. Hunt continued, and psychic treatment is usually the best to restore a normal eliminative habit to the bowel. While many take purgatives regularly for years without injury, it is a useless and can be a dangerous procedure. A faithless husband causes worse constipation than hosts of bacteria, and the calm of Marcus Aurelius is better than a dozen colonic baths.

An interesting recent theory is that of Robert and Doyle, published in the *Journal of Nutrition* (May, 1935). These men worked on rats, it is true, but their results are suggestive. When young rats are fed diets low in minerals they have marked intestinal stasis, becoming badly constipated. Rats on high mineral diets do not show this symptom. Vitamin B does not aid the rats on low-mineral diets, but if calcium and potassium carbonates are added to their diets they get relief.

Now, since constipation is most prevalent among civilized peoples who eat minerally deficient foods such as highly processed sugar and white flour, the theory holds that their minerals may be out of kilter. In fact the water in which vegetables are boiled is usually thrown away, the minerals going with it; potassium especially. Perhaps, then, the potassium-to-calcium ratio in the diet is an important factor in preventing constipation, these workers say.



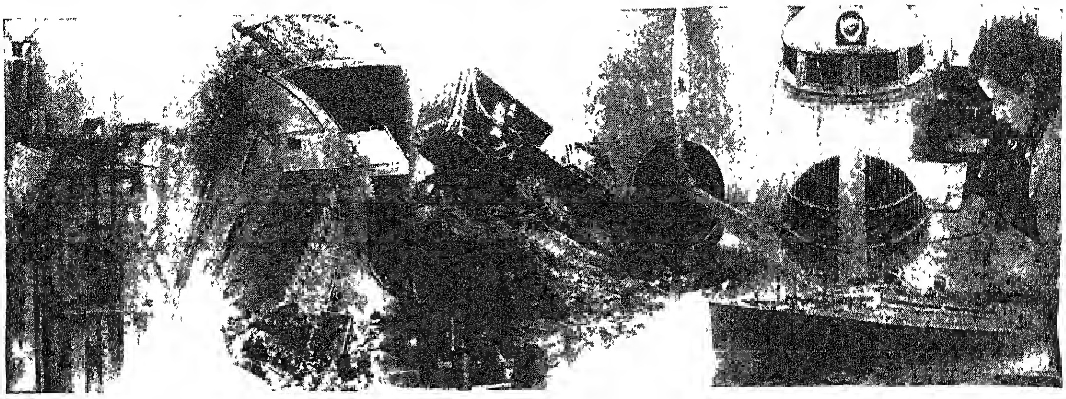
George P. Larrick, Chief Inspector of the Food and Drug Administration, with some of the patent medicines that have been put out under misleading labels

Dr. Irving A. Frisch, New York pediatrician, reassures us still further. He produced artificial constipation in 12 perfectly well and normal children, and in five with fevers, for periods of from 6 to 68 days. He did this by giving them a weak opium tincture. Each child had but one small stool per 11 days, on the average. They continued at their usual habits and diet. They remained happy and comfortable. They had no headache or lassitude. They gained one pound each in weight during the test. Few had pains or discomforts of any sort from accumulated feces, though some did. Their temperature, pulse, red blood count, hemoglobin, white blood count, and urine remained normal and unchanged. Other findings were negative.

These constipated children had no vertigo, frontal headache, neuritis, insomnia, bad dreams, lack of concentration, hysteria, convulsions, fever, furred tongue, bad taste, foul breath, gas, poor appetite, colicky pains, cold extremities, sallow complexions, skin affections, anemia, palpitation of the heart—not one of these hallowed symptoms of constipation that advertisers tell us to watch turned up. So avoid needless cathartics.

Very broadly speaking, the present generation of Americans has been reared in the traditional belief that the bowels must move daily and that, if they do not do so, something is radically wrong. But, strange as it may appear, there are cases recorded in the medical literature where individuals went not only weeks but even months without intestinal evacuation. Stranger still, many of them complained relatively little. Such a condition is not normal but that is not the point. The point is that relative good health may be maintained by individuals who do not by any means follow the daily schedule. On the other hand, increasing constipation and actual ill-health may follow persistent worrying about the intestinal functions and the use of drugs to goad the bowel into action.

JUST as some of us eat rapidly and some slowly, so the intestinal tracts of some of us handle food rapidly and others slowly. If individuals with a naturally slow bowel persist in using cathartics they undermine their own nourishment by ridding themselves of food from which their organs have not yet extracted the nutriment. Many maintain excellent health on three, two, or even one bowel movement weekly. The moral seems to be, let Nature set her own pace, for she usually knows much better what she is about than we do.



# THE SCIENTIFIC AMERICAN DIGEST

Conducted by F. D. McHUGH

Contributing Editors

ALEXANDER KLEMIN
In charge, Daniel Guggenheim School of Aeronautics, New York University

D. H. KILLEFFER
Chemical Engineer

## Comfort to Kneeling Church-Goers

THE latest innovation in modern and comfortable church equipment is a kneeling bench which features sponge rubber upholstery. The bench itself is no different in design from the old bone-bruising type except that it is covered with a one-inch-thick slab of sponge rubber which in turn is covered with leather or high-grade Fabricoid.

Comfort in prayer

## Man's Insignificance

DESPITE the activities of civilization and the changes wrought by man in his environment, which to him have seemed colossal, the total effect on nature, according to Robert E. Wilson writing in *Industrial & Engineering Chemistry*, has been negligible. The 50 billion tons of carbon contained in fuels mined during the last 50 years would, on burning, produce approximately 180 billion tons of carbon dioxide. This apparently tremendous quantity might be expected to be sufficient to snuff out most of the animal life in the world, Dr. Wilson says, but actually this stupendous total is so small as compared with the volume of the atmosphere that if all of it were dumped in the air and none removed it would increase its carbon dioxide content from 30 parts per 100,000 to only 32 parts, an insignificant change. The water of the oceans contains some 30 to 40 times as much carbon dioxide as does the atmos- ... the sea which maintains the composition of our atmosphere constant. Since man's inroads into fuel have been greater than any other of his alterations of nature, Dr. Wilson believes man has no right to puff himself up.—*D. H. K.*

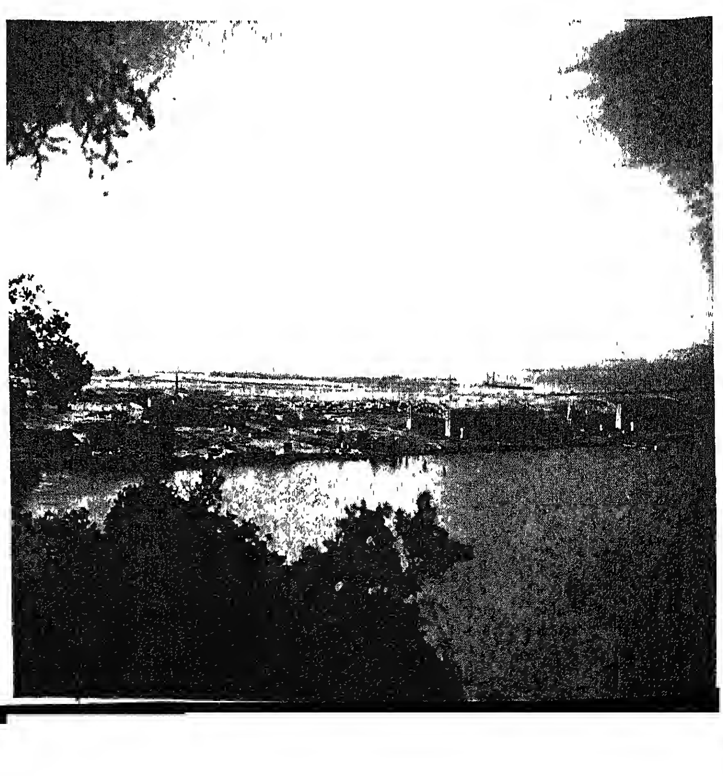
## Building from the Roof Down

CONCRETE walls that hang clear of the ground, and steel framework that rolls with the wind are embodied in the design of two huge airplane hangars being built on the site of the 1939 Golden Gate International Exposition on San Francisco Bay.

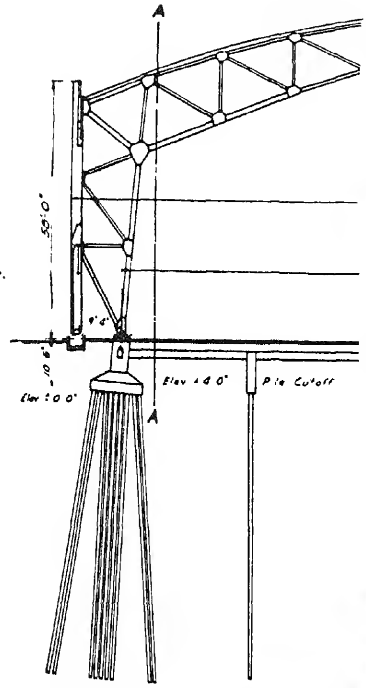
These two hangars, 287 by 335 feet in dimension, ranking among the largest ever constructed, are of three-hinged arch construction designed by Exposition engineers, under the supervision of John J. Gould.

Walls are cantilevered outside the lower arch pins, counterbalancing the weight of the roof and reducing arch thrusts to a minimum. With this design, the tension on horizontal ties is computed at 18,000 pounds as against 74,000 pounds without cantilevering the walls. This results in a substantial saving in concrete foundations and steel. At the bottom of the walls, between the wall and the foundation trench, flexible joints of copper sheeting are provided to permit movement due to wind pressure and temperature changes. Flexible joints are also provided at the ridge of the roof.

Main columns of the arches rise from lower hinge pins 6½ inches in diameter and 24 inches long, supported by an all-welded steel base bolted to concrete piers. Foundations for the 10 arches of each hangar are concrete piers 11 feet deep resting upon 70-foot timber piles. Central arches rest upon 18 piles and the two end arches are jointly supported by 45 piles.



In pouring concrete, forms were suspended from purlin trusses by means of a rod supporting one end of an I-beam beneath the forms, the other end being shored up from the ground. This method of pouring allowed a gradual application of wall loads to the structural steel frame and foundations. Completed, each wall, 335 feet long




The concrete walls of the hangars are suspended clear of the ground

and 58 feet high, weighs 1,703,000 pounds with corner pylons. Approximately 1000 tons of steel were used in each hangar.

These structures, which will be used as exhibit palaces during the 1939 World's Fair, will later serve as a nucleus of a new San Francisco Municipal Airport. To conform with the general architectural plan of the Exposition, the ends of the hangars will be enclosed by plaster and steel. Hangar doors with an opening of 200 feet by 40 feet in height will be installed at the termination of the Exposition. These openings are so designed that the doors may be extended to a height of 65 feet for a distance of 30 feet in the center to admit transport planes with towering tail structures that may be constructed in the future.

For the purposes of the Exposition and also for future use as airplane hangars, the maximum amount of clear floor space was needed. Trusses were designed to give a clear span of 217 feet and a clearance in the center of 65 feet. Vertical bracings are used only in alternate bays of 41 feet, and are so placed as to give maximum clearance.

**LUMINESCENCE**

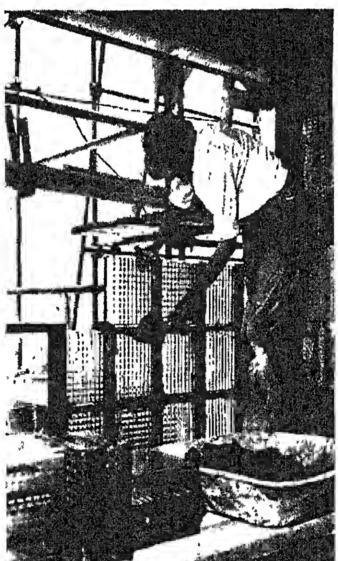
**NEW luminous colors in the form of lacquers, water colors, artist oils, and costume dips are now available for creating spectacular effects. These colors glow vividly when exposed in darkness to "black light."**

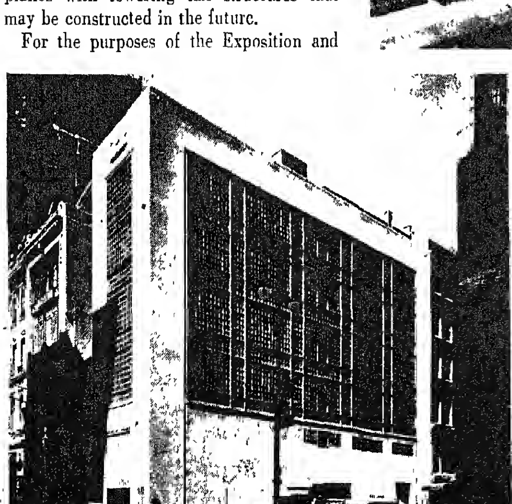
## Glass-Walled Offices

FIFTH Avenue, New York City, has the latest glass house. It is a five-story office building which, appropriately enough, houses the offices of the Corning Glass Company and certain affiliated companies. The new building is of fire-proof construction throughout, the exterior walls consisting of great screens of glass construction units framed in Indiana limestone. It is completely air conditioned.

The large glass blocks used in constructing the panels are similar to those which have been used in a number of smaller buildings and for sections of some homes. These are approximately a foot square and four inches thick and are made of the same heat-resisting glass used in the manufacture of Pyrex oven-ware, and, incidentally, of the huge telescope mirror now being ground into shape out in California. Their size is large compared with building brick, reducing the cost of installation and the number of mortar joints. Carefully designed fluting on the inside face of each unit provides ever-changing decorative effects, insures diffusion of light, obscures images, and produces no lens effect.

One particular advantage which these glass bricks have over ordinary plate glass is that they provide most efficient insulation against the transfer of heat since each brick is hollow. Widespread use of air conditioning today makes such positive insulation more necessary than ever before in new construction.





***Above:*** **Placing glass construction blocks in a wall of New York's first glass office building.** ***Left:*** **The completed exterior of the building. The trim used is nickel-silver and Indiana limestone**

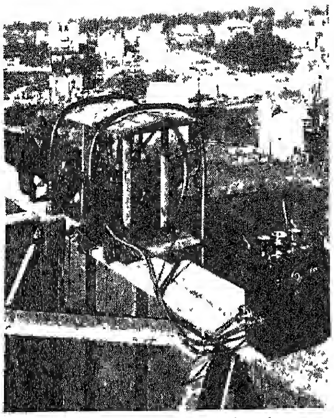
**How the new binocular loupe is fitted to an accurately adjusted frame**

## Loupe For Your "Specs"

A NEW binocular loupe, distinguished from previous magnifiers by a unique design which allows it to be fitted to the individual wearer, will benefit a wide range of professions, occupations, and industries, according to the laboratories of Bausch & Lomb Optical Company, in which it was designed.

Three-power magnifying lenses, providing stereoscopic vision, are mounted on the end of a bar extending out from the specially designed frame and bridge. A flip of the finger throws the magnifier up and out of the line of vision when desired. Even when worn constantly, however, comfort is assured by the method of construction, which permits accurate fitting of the frame by changing bridge width and inter-pupillary distance for individual cases.

The loupe is essentially a spectacle frame with an ingenious aluminum block in place of a bridge. Round eyewires are mounted on slotted bars and held to the bridge block by a set screw. By loosening the set screw each eyewire can be adjusted separately to get the proper inter-pupillary distance for



Of German design is this latest portable X-ray equipment that is being used to locate defects in the interior of bridge girders. The X-ray tube is mounted on the movable platform and is connected to the controlling cabinet by means of heavy cables. There also are located the high-voltage transformers that supply potential to the tube

mounted on the bridge block so that their separation may be adapted to the individual. Proper adjustments are made by competent fitters when the loupe is purchased.

When the user ordinarily wears correcting lenses these may be mounted in the eyewires.

In the professions of surgery, dentistry, ophthalmology, and other branches of medicine a three-dimensional magnified view of an object is often desired. This is no less true for laboratory workers, artists, etchers, engravers, clock and watch makers, photo-engravers, diamond setters, locksmiths, and in the retail, wholesale, and manufacturing jewelry establishments. The new loupe is believed to embody all the desired qualities that provide comfort for workers requiring magnification for close work.

## Simple Flame-Proofing Chemical

FLAMEPROOFING of curtains, drapes, upholstery, rugs, and so on, formerly a complicated and uncertain process, has now been made simple and fool-proof by the research laboratories of the Laboratory Equipment Company.

The flame-proofing material developed by this company is called Ignex, and it can be applied in the home, office, or factory by anyone without the use of special equipment. It eliminates the horror of fire so often started by careless smokers throwing lighted cigarettes and matches on rugs or curtains.

Ignex is a clear liquid, non-poisonous and not harmful even to the most delicate fabrics and colors which are not affected by water. It is applied by dipping or spraying. Unlike most flame-proofing materials, Ignex is tenacious and does not "powder off" the fabric to which it is applied. It is not visible even on black materials. Because it is neutral and remains so, it does not tender or

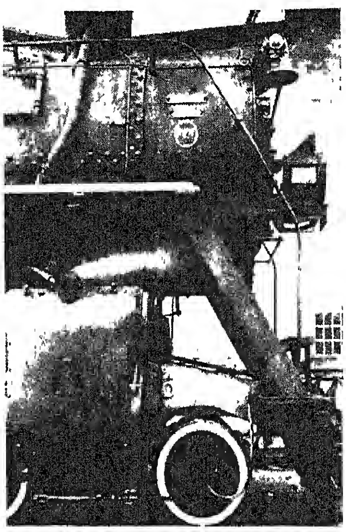
# TRANSPORTATION SECTION

of course, that such materials are not harmed by plain water.

This new compound is being used for flameproofing silk, rayon, wool, cotton, paper, leather, and many other flammable materials. Materials treated with Ignex have been tested and approved by the New York City Fire Department and many chemists and commercial laboratories.

## Locomotives Use Electric Speedometers

SPEEDOMETERS have long aided automobile operation, and now modern steam and electric locomotives are finding



*Above:* The speedometer generator mounted on the axle of a locomotive. *Right:* Indicating dial in cab

the newly developed, all-electric speedometer an increasingly useful instrument. One of our illustrations shows the front end of a locomotive, the Westinghouse alternating current generator being mounted on the end of the axle by four heavy bolts; direct mounting simplifies maintenance and avoids use of gears, belts, pulleys, or friction drive. The short cable allows necessary flexibility when going around curves. The other picture, taken in the cab, shows the steam-proof speedometer (instrument shown by arrow) which gives the engineer a continuous indication of miles per hour. The speedometer is electrically connected to the generator by armored cable and wires.

## Roadside Betterment

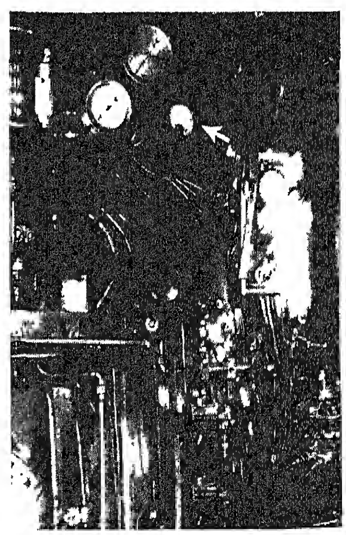
MANY roads in eastern America owe their monotonous similarity to the brush-scythe of the roadside supervisor. Only the hardiest weeds and the most objectionable plants survive the indiscriminate cutting which is characteristic of the old days of roadside supervisors, and which sorrowfully continues to be characteristic of the work done each spring in many places without either knowledge or adequate supervision.

It was in Amherst in 1920 ...

which was to include not only satisfactory footpaths to remove the penalty against pedestrianism, but was to make the roadside a living museum of the natural growth of the land. It would not be difficult, with the use of sympathetic knowledge, to cultivate and preserve rather than to destroy the beautiful things which Nature puts within our reach along the highways of America. It would seem possible also to have communities undertake to safeguard and develop sections of such rural highways as a cherished possession so that, for example, one town might take care of its asters and goldenrods, and another its laurel and rhododendron and huckleberries, to the joy of the passer-by and the glory of God.

Essentially there should be nothing to interfere with the adequate width of traffic space, and with equally adequate but yet undeveloped footpaths. With these as the major considerations, then, all the nearby world would be left for sympathetic protection and development. Such work would be preserving and guiding natural development instead of substituting ruthless destruction, often followed by senseless planting of exotics.

To my mind, such roadside development sympathetically carried out should admit no exotics at all, though there could be trans-



fers and condensations within reasonable geographic limits.

The beauty of every State and the travel value of every road can be enhanced and protected if the thing here suggested is done with spirit and understanding.—*J. Horace McFarland, in "A Handbook of Conservation."*

## Visitors Travel Faster

VISITORS travel faster than the home folks on the highways, and the farther they come the faster they go, according to a traffic survey by the Federal Bureau of Public Roads and the Connecticut State Highway Department. As reported in *Public Roads*, the Bureau journal of highway research, Connecticut cars averaged 38.2

41.3 miles; and from four midwestern states, 44.9 miles an hour in the daylight during the summer.

There was no significant difference in the average speed of men and women drivers. Men average a little faster in the winter; women in the summer. But back seat drivers put on the brakes. That is, cars with passengers did not travel as fast on the average as cars with only a driver aboard. In the winter this difference in speed averaged only about half a mile an hour, but in the summer it was two miles.

Average speeds were fastest in the early morning, slowed gradually during the day, picked up a little from 5 to 6 P.M., and lessened in the dark hours.

The driving records of 981 high-speed drivers were checked against the records of 1054 moderate drivers. Thirty percent more of the fast drivers had been in accidents and they averaged 45 percent more accidents than those who drove at moderate speeds.

The timing was done with the aid of a stop watch and mirrors from a car parked at the side of the road.

## Clickety-Click of Rail Joints May Be Doomed

THE "clickety-click" that has been a traditional part of train travel since the laying of the first steel rail, may be doomed to eventual extinction in the march of scientific research.

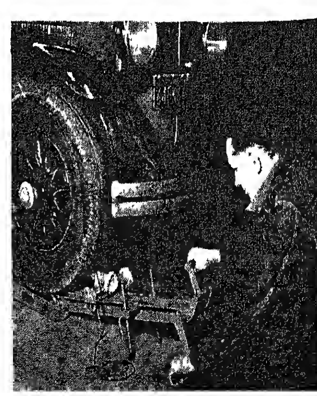
It was revealed recently that Southern Pacific for the past two years has been testing a two-mile stretch of track near Tucson, Arizona, over which the train wheels roll almost noiselessly. The track lies between Neviska and Avra on the main line of the Sunset Route.

The special track has mitered joints between the lengths of rail instead of the usual square-cut butt joints. As a result, train wheels roll onto the tip of each successive length of rail before they leave the tip of the last, and the click is practically eliminated.

Southern Pacific officials pointed out that in addition to providing a quieter ride, the new rail design is expected to minimize the usual wear on the ends of rail lengths.

## Tires Regrooved, Rejuvenated

SERVICE stations, garages, car dealers and fleet owners have learned to increase mileage and add safety to smooth tires, through the use of the "Roll-About"



tire groover. This inexpensive unit, which is said to have received the approval of several of the major tire companies, is made by the Safe Tool Manufacturing Company.

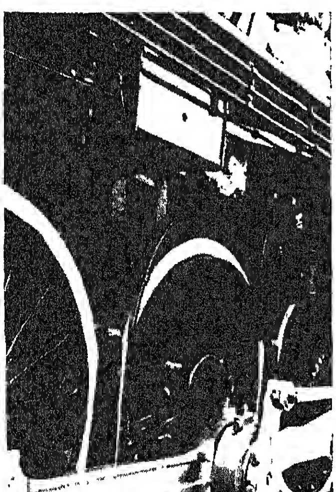
The "Roll-About" groover is designed to permit the re-grooving of a tire without its removal from the wheel or car. The car is simply jacked-up, the groover rolled underneath, and enough of the weight allowed to rest on the rollers so that when the operator turns the handles of the grooving machine the wheel of the car is turned by contact with the tire-supporting rollers.

The cutting device consists of a double-edge knife, mounted on a carriage, which has both in-and-out and crosswise adjustment, so that the operator has quick and easy control of the depth and position of the grooves he is cutting.

The entire operation takes approximately five minutes. This speed, coupled with accuracy and ease of operation, has resulted in the use of a great many of these grooving machines throughout the automobile industry.—*Link-Belt News.*

## Progress in Steam Locomotives

PROGRESS in steam locomotive design to meet modern demands for high speed has had principally to do with running gear.



Lighter reciprocating parts

Reciprocating parts of the driving mechanism have been substantially lightened by making them of high-tensile alloy steels. Driving wheels are being built to new designs for greater strength and for better balancing of reciprocating and rotating parts to reduce stresses on engine and track at modern high speeds. Railroad men rely principally on steam power for road service and, despite the growth of Diesel and electric services, feel the steam locomotives must continue to haul most trains. These improvements in running gear are considered more important than streamlining of locomotives.—*D. H. K.*

## Increased Road Safety

ON many motor roads where wide flat

a car may easily leave the pavement, especially at night. Recent erection beside the pavement of black and white plaques bearing red reflector studs has proved helpful to drivers at night. The plaques are spaced 330 feet apart on straight stretches and 165 feet on curves, and are placed obliquely to reflect illumination from headlights at a distance.—*Road Abstracts.*

*(End of Transportation Section)*

## SAFE AND SIMPLE

THE drinking of two or three glasses of salty water before breakfast is sometimes a most satisfactory method of relieving constipation. We cannot see how it could possibly have a deleterious effect even if used throughout a lifetime. The principle appears to be that a *physiologic solution* of sodium chloride at body temperature is not held back at the pylorus but runs right on down through the small bowel. Here again it appears to be neither absorbed nor diluted and hence it runs on into the colon, where it serves to bring about an evacuation.

Because the pylorus holds back cold liquids, the water should not be iced, and it must be taken before the pylorus is somewhat closed by the presence of food in the stomach. In order to make a physiologic solution of sodium chloride about a third of a teaspoonful of table salt should be added to each glass of water. Three or four glasses should be drunk before breakfast while the morning toilet is being made.—*Journal of the American Medical Association.*

**TUNNEL**

**UNDER the Maas River at Rotterdam, Holland, a box-shaped tunnel will soon provide a crossing for motor vehicles, pedestrians, and cyclists. This tunnel is unusual in that it will be built on shore, transported to its location, and sunk in place.**

## IMITATING NATURE IN PLASTICS

MANUFACTURED products ordinarily are quite uniform in their characteristics, while those of natural origin owe their beauty to irregularities and lack of uniformity. In the plastic industry, some of the most difficult problems have been encountered in efforts to produce artistic effects in man-made materials resembling those to be found in tortoise shell, ivory, and mother-of-pearl. To imitate tortoise shell markings, two soft batches of plastic colored amber and brown, respectively, are passed repeatedly through mixing rolls to secure a proper blending; the process is stopped before complete mixing has been achieved. Ivory is imitated by stacking together thin sheets of plastic in which each alternate sheet has more pigment than its immediate neighbors, pressing to amalgamate the sheets, and slicing off the grained sheets vertical to the piling. Further rolling and pressing give these slices pleasing irregularity of grain. Iridescence and mother-of-pearl effects are produced by introducing a preparation, made from the scales of certain fish, containing tiny pearl

with the plastic base to prevent their coagulation, which would destroy their beauty, requires the greatest care; subsequently the plastic must be drawn out into sheets to assure the arrangement of as many particles as possible parallel to the surface. Synthetic pearl essences, based on mercurous chloride (calomel) and lead carbonate crystals or on metallic powders, are not equal to the fish-scale product.—*D. H. K.*

**SLOGAN**

**PRIZES totaling 300 dollars are offered by the Exposition of the Chemical Industries to be held in New York next December for a slogan which will impress the public with the importance of chemistry's contribution to human welfare.**

## Relief for Cherry-Pie Eaters

RELIEF for cherry-pie eaters appears in the latest revision of government standards for canned fruits and vegetables which goes into effect October 10. Only cherries in which there is not more than one pit to every 20 ounces, instead of one pit in 10 ounces as had been the rule, will be regarded as of standard quality. Twenty ounces is about the weight of a No. 2 can of pitted cherries.

With reasonable care, says the Food and Drug Administration, canners can so handle cherries as to get out practically every pit. The best canners do this, but some have allowed too many pits to go into the cans. Cherries with more pits than the 1 to 20 ratio may still be marketed if labeled "partially pitted" and bear the sub-standard legend, thus giving warning to pie makers and pie eaters.

Other minor revisions include: A slightly higher minimum requirement for sweetness of sugar syrup on canned pears and a wider latitude in the sizing of canned fruits, with the provision that products which "go out of bounds" in this respect alone may be labeled simply "Ungraded for Size." There is now complete uniformity in labeling of all sub-standard products for which quality standards have been promulgated, viz.: Peaches, pears, apricots, two styles of cherries, tomatoes, peas, and dried peas. Any of these canned products below the standard may be marketed if they are wholesome and in sanitary condition, but they must be labeled "Below U. S. Standard—Good Food—Not High Grade."

## Air Conditioning at 50 Cents a Day

ENGINEERS at the University of Illinois, Urbana, working in a "research residence" have determined that a seven-room home, under conditions existing in that locality, may be artificially cooled and air conditioned throughout a four months' summer season at an operating cost as little as 50 cents per day. Their findings, made public in a recent engineering bulletin, are the result of tests extending over a period of three years undertaken in co-operation with the research laboratory of the American

# THE AMATEUR TELESCOPE MAKER

**Conducted by ALBERT G. INGALLS**

FROM the Old World come photographs and descriptions of three telescopes shown on this and the facing page. Harold W. Cox, 47 Upper Green, Mitcham, Surrey, England, who works with his brother, Lawrence A. Cox, sends the photograph in Figure 1. He writes:

"The main reflector is a 12", *f*/8 affair,

*Figure 1:* Cox and Cox

and provision is made for photographing both at primary focus and with a magnifying eyepiece. For photographing star fields we have fitted a camera on the other side of the polar axis, for which we made our own 4", *f*/6 lens. When the Schmidt we are making is ready we will probably mount it in place of this camera. When photographing with the star field camera we use the 12" reflector as a following telescope, and when photographing with the reflector we use the 4" refractor shown on the photographic attachment.

"Our telescope mount is driven by a synchronous motor which in turn is driven from an oscillator. An oscillating valve drives two power valves in push-pull and the output, five watts, is ample to drive the telescope with plenty of reserve power. An H. F. pentode valve oscillating as a Dow oscillator has part of its capacity on the tuned circuit connected to a switch, so that the addition or reduction of capacity varies the frequency of the oscillator and hence the frequency of the supply to the motor.

"I have been carrying on some very intensive investigations into stable oscillators and I have utilized the results of this work when designing my own oscillator for the telescope drive. This oscillator, going off at 50 cycles, will remain constant in frequency to about 0.05 percent during an evening's run of several hours. This actual drift is negligible compared with errors due to refraction in the atmosphere and, as the speed of the motor is hand controlled, the small but steady drifts can be taken care of. The variation in capacity is by means of a two-flick switch held in the hand at the end of a flexible shielded lead, and bring small really very nice to handle. We have had this control in operation for about 15 months and have never had the slightest bit of trouble with it."

The two Coxes wish to get in touch with American amateurs. They are making a variety of things, including a Schmidt camera, an aluminizing outfit, and an automatic guiding rig. They have just finished an observatory for the telescope shown in Figure 1 and, with a diameter of 10', this has a slot that can be opened to 66" because of the spread of their camera and telescope.

IN Figure 2 is another Briton's telescope, the maker of the optics in it being Horace E. Dall, 166 Stockingstone Road, Luton, Bedfordshire, England. Dall is the author of two chapters in ATMA and his vocation is research and design for a firm that manufactures industrial measuring and controlling instruments, particularly for water, steam, gas, air, oil, and other fluid flow. Someone nicknamed the 'scope the "jack-knife" telescope and it apparently stuck. Dall writes:

"It's not everybody's luck to possess a first-class astronomical object glass of large aperture, but possession of the O.G. is only part of the battle. The usual focal length is anything from 13 to 17 diameters and the rigid mounting of such a long telescope on a stand tall enough to give comfortable vision at the eye end is no light job.

"Captain M. A. Ainslie, of Bournemouth, England, possessed an 8½" object glass of 10' focus, and having decided that the ordinary long tube mounting was too cumbersome to consider, schemed out a system of folding which better than halves the length and gives far more comfortable vision—even than a standard refractor fitted with star diagonal.

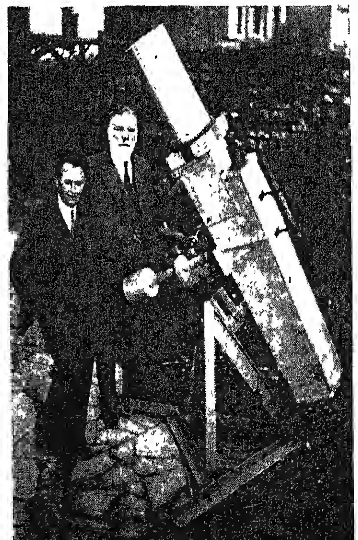
"Only one additional reflection is needed, in comparison with the latter, and the final image has the advantage of normal astronomical inversion, while the eye tube can be swung round to suit any chosen angle of view either for comfort or orientation of image (see end elevation). It will be seen that the center of gravity of the system comes fairly near to the eyepiece mount. This adds further to the comfort by reducing the range of movement of the eyepiece.

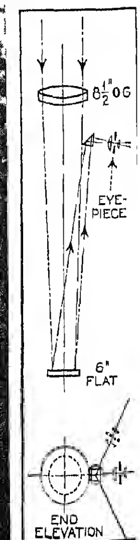
"The illustration shows the details of the sturdy portable form of equatorial mounting adopted—with slow motion and circles. A long dew cap is fitted to the O.G. and the whole tube is of wood and covered with zinc for working in the open. Mr. Perry (Figure 2, left) of Luton built the entire stand and tube, while the optical items and ... self. The instrument is now in regular use (mostly on planetary work) by Captain Ainslie (at right in Figure 2), who is one of England's most prominent amateur astronomers. He also possesses a reflector of larger aperture (9") made by himself many years ago, and the use of the two instruments side by side entirely confirms the well-recognized fact that a refractor (folded or not) gives much steadier images than a reflector—though on comparatively rare occasions the latter shows to advantage."

THIRD of these three overseas items is a communication from W. H. Haase, Kramatlaan 22, Batavia-Centrum, Netherlands East Indies, who says that, 30 years ago in Holland, he made a simple telescope and that he now has a medium-sized refractor. His comments are:

"In ATM, as a fit instrument for amateurs you put the Newtonian reflector well to the front; the Cassegranian and Gregorian come respectively second and third. As to the Herschelian, you remark on page 449 that it is favored by few and you give the reasons why. Anybody having practical experience with the instruments will agree with the order of use as given by you. Yet there exists or has existed a fifth possibility, a handy *combination* of the Herschelian and the Cassegranian, which is not mentioned in ATM. I enclose a sketch of the principle (Figure 3).

"This combination was constructed around 1900 by K. Fritsch of Vienna and its principal advantages are the total elimination of obstructions from the field of the primary and the fact that no perforation of the latter is needed—certainly no negligible points when compared with the dimensions of the secondaries in the tubes of the Cassegranian and the Gregorian reflectors. If the 'brachyte' (the combination is called *brachiet* in Dutch, so I translate literally) is used, more incoming rays are gained and the reflective power is greater than in other





types of the same opening, or aperture.

"I cite data from a Dutch book on astronomical instruments—J. Weeder. 'De sterrenhemel doorzocht met teleskoop en mikroskoop,' edited by A. W. Sijthoff, Leiden, Holland. When put on the market by Fritsch the instrument was welcomed warmly on account of its shortness, lightness, relative power, and cheapness. The astigmatism which the Herschelian shows

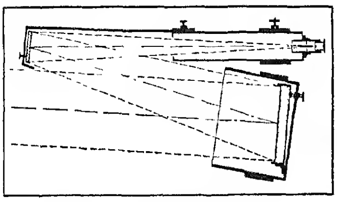


*Figure 3:* The brachyte 'scope

on account of the inclination of the primary cannot have been a serious drawback. On the contrary, Weeder cites N. von Konkoly who found that the brachyte would make 'the best instrument for amateurs'. The sharpness of the images is called remarkable. In a 4" brachyte, magnifying 250 times, the planets showed clear outlines. The ravines near Hyginus and Petavius on the moon, the Triesnecker system and even the small craters in Cleomedes could be very clearly defined. Body heat, a serious source of trouble in the Herschelian, will practically have no effect in the brachyte."

TO get fun from telescope making it is not necessary to own an elaborate workshop. The instrument shown in Figure 4 was made by Orville Guthrie, R. F. D. 2, Mukwanago, Wis., from whatever came to hand, including part of an old bicycle pump. If the optical elements in the 'scope are good the performance may excel that of a swank appearing job having poor optics. The 'scope

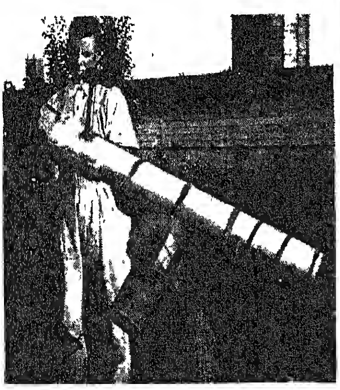


*Figure 4:* Moon on the farm

shown in the figure is being used for lunar photography and Guthrie labels the photograph "bringing the moon down to the farm."

ANONYMOUSLY a writer who wishes to remain a shrinking violet sends us the following description of the telescope shown in Figure 5—a 'scope whose heavy design would seem to indicate that Russell W. Porter's plea for ruggedness had taken root or else that the maker, unlike many others, was born with ideas of solidity in mechanisms.

"I send a picture of a home-made 10½"

Wilmington, Calif., a mechanic employed by one of the nearby oil refineries. In response to my questions Mr. Coopridei tells me that the pedestal is made from a piece of 10" steel tubing with a steel plate three quarters of an inch thick and 20" in diameter welded to the bottom. Good use is made of a 6" malleable iron "T." The tube is of 20-gage galvanized iron broken every 2" to form a 12" tube 8' long and is supported in two 12" ball bearings, in which it may be revolved to bring the eyepiece to any position desired by the observer. The electrically driven clock is placed within the

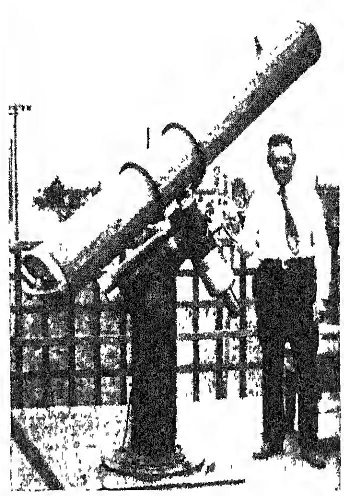


*Figure 5.* **Rugged solidity**

tube supporting the polar axis. The mirror is mounted in an aluminum cell on a three-point suspension.

AUTOMATIC *guiding again.* Lawrence Braymer, Honey Hollow Farm, Lahaska, Pa., who helped Ritchey build the 40" aplanatic Ritchey-Chrétien reflector at the U. S. Naval Observatory and who has a Gerrish telescope (ATM, p. 50, No. IV) with 12¼" flat, sends us a note on this subject, saying: "I think this is a new line of attack on guiding. I gave a lot of thought to it in 1931 but it's one of those things a fellow doesn't get to." Here is the note:

"An automatic guiding device should aim at keeping a 'perfect' cone of rays on exactly the same spot of the sensitive film so that each cone can pour out its quanta of light energy on exactly the same area. Let us expose a plate for 100 minutes. If we get a star image ten diameters larger than the focal point of the cone, we have certainly missed a bet, because the area that our cone has persuaded to turn black is then 100 times its own area and we have taken 100 minutes to secure what we could have got in one minute if our guiding were perfect. (Other factors enter here, but just for fun let's overlook them.) Now, while we are exposing our plate to induce the silver bromide molecules to turn black in spots, old man sky fog is at work on every molecule of our emulsion, and after four or five hours has put a limit to our exposure by trying to turn it black all over.

"Assuming a perfect guiding mechanism in one plane, a limit is set by sky fog and another limit is set by focal error. One-plane guiding does not attempt to correct which permits the rays to strike the plate only at those times when everything is perfect? Instead of trying to follow the wiggles of the cone of light by moving a heavy plate, why not build up our image at selected instants alone?—that is, at those instants when everything is lined up and bad seeing has not made our star image look like a fried egg. In short, the rays are 'on the button' or no exposure; and, in the meantime, no sky fog. If we could do this we might get some very different looking plates. We might thus guide for 100 minutes yet get, say, two minutes' actual exposure on our plate. But these two-minute images would be *smaller and darker than* the images on the 100-minute plate we considered above; and, instead of a 100-minute sky fog, we have only two-minute sky fog. If we could succeed in getting our machine to occult when the cone of rays shifted about half of its area, we might get an overlapping effect, as shown in Figure 6 at the top left. At the top right in the same figure is shown the result of many closings—the central area receives more light. This is the result we would be shooting at.

"The lower drawing shows the general idea. Two guide stars might be used, to increase light and account for rotation of field. When the focal area is 'on the button' of the occulting disk (in this case a tiny cylinder formed by a bright wire of suitable size), the shutter is open. Any change in position of the cone apex spills light into the cell, which trips the shutter. Dr. Zworykin suggested a rotary shutter moving in one direction, like a movie camera shutter, driven by a spiral spring kept wound through a slipping clutch by a Telechron motor. The amplified photo-cell current trips a ratchet on the rotary shaft. Dr. Zworykin said in 1931 that RCA had used a similar shutter of extremely thin aluminum, and secured operating speed of 1/200 of a second. Camera shutters secure speed by only partially opening, hence are not suitable. The cell might be threshold sensitized in several ways by light leakage from a controlled source. An alternating current, for example, might be impressed by admission of light from a gaseous tube (Zworykin and Wilson, "Photocells and Their Application," 2nd ed., page 205 and following). The electron multiplier should be pertinent in connection with any such device. In operation, the observer would devote his time to readjusting the guiding head every time the shutter stopped clicking. It would stop exposing whenever the cone was not waving around over the 'button,' or when the 'button' was either inside or outside of focus.

"Many fascinating angles occur in considering such a gadget. I worried a lot over 'occulting disks', but felt better about them after trying it visually. I spattered a droplet of mercury on a microscope slide in balsam and pressed on a cover glass, getting hundreds of tiny opaque disks. I chose one the right size and occulted artificial star images from a refractor. If the eye is any judge, the effect was good. Note that little light is lost by reflecting surfaces. The idea of occulting during periods of bad seeing is due, of course, to Ritchey, who says he has guided with both hands and tripped a flap shutter by a device held between his teeth.

"In many hours of consideration of the guiding problem I could think of no other

ter of contrast, no other system seemed to permit of such great *effective* exposure times."

IN the *Review of Scientific Instruments* for July, 1937, Charles H. Tindal of the Warner and Swasey Observatory, Case School of Applied Science, Cleveland, Ohio, briefly describes his pendulum-controlled telescope drive. This is a modification of

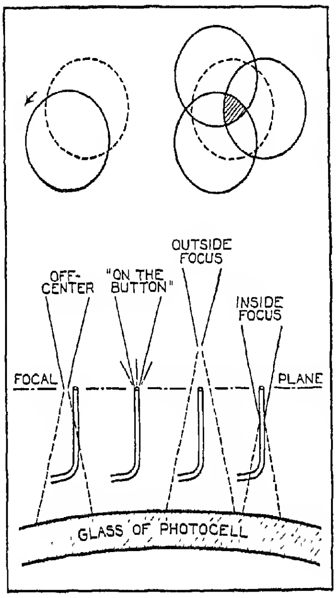
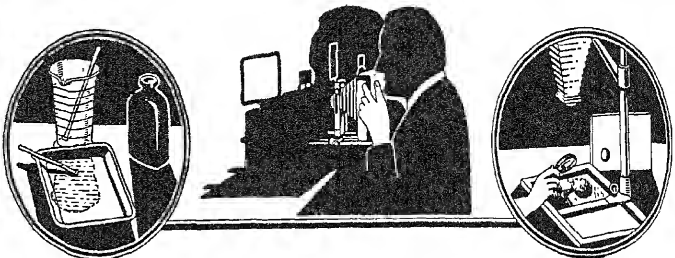



*Figure 6:* Braymer's system

the Gerrish drive described in Bell, "The Telescope," and is for the purpose of correcting the inaccuracies of commercial synchronized power. A limited number of reprints are available for loan to those who are interested.

IT looks at present as though the RFT, or Richest-Field Telescope, described by Walkden in the final chapter of ATMA, were destined for very considerable popularity. We have seen several, and know that others are being planned or made. Last August, when your scribe was at the annual unconventional convention of amateur telescope makers at *Stellafane*, Finsler's Comet was near the Dipper and everybody wanted a look-see at it. Through ordinary telescopes, even quite large ones, this proved disappointing, the comet being so thin and nebulous. However, two RFT's brought there by Cox of New York, when simply held in the arms like a howling baby (ATMA, p. 639), revealed head, tail, and striations quite neatly, for these short-focus 'scopes are good light gatherers. Directed toward star clouds in the Galaxy, these RFT's proved easily to be all that Walkden claims in ATMA. We should like to publish, some time next winter, a flock of photographs of owners of RFT's with their RFT babes in arms—a sort of "RFT Club." Please send.

A governing factor in RFT design is the number of stars per galactic field of view, and the data given in ATMA were based on *average* galactic fields. But suppose we single out some especially dense regions of the Galaxy, like Cygnus, and design an RFT, or a RRFT, for that alone. This would be a "special purpose" RRFT, giving still more striking views in those regions.



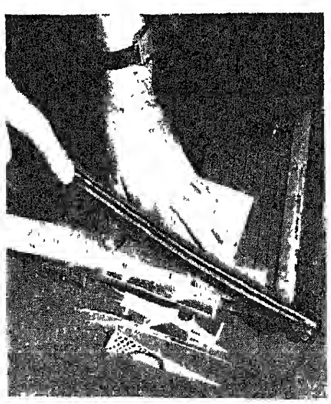
# CAMERA ANGLES

Conducted by JACOB DESCHIN

## WORK PROGRESS PICTURES

ANYONE who has ever made anything, whether a photographic lamp shade or a house, built a garden, bound a book or whatever, will tell you that he took more delight in the actual work involved than in the final result. Somehow, the finished thing seemed like the end of a pleasant journey. This brings out the sentimental side of making work progress pictures; that is, taking pictures of various details of the work you are doing to show at the last a complete and continuous series of photographs illustrating the step-by-step progression involved in the project.

But from the practical point of view, the value of step-by-step pictures is often a matter of dollars and cents. If you have ever written an article for one of the popular mechanical magazines or other publication in which you described the making of something or other, you will need no arguments



Progress on a lamp shade (1)

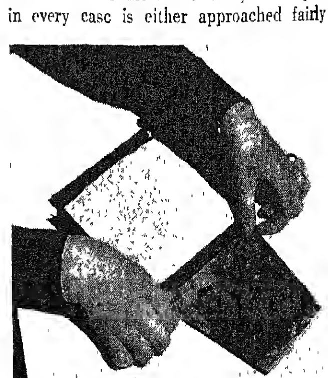
from this department to show you how valuable such a series of pictures was (or would have been), not only in graphically supplementing the text but in raising the amount of your check.

If you belong to a hobby club of some sort and have occasion to make original lecture contributions to your fellow hobbyists on some phase of your mutual interest, such, for example, as arranging a fish tank with the various odds and ends that go to simulate the bottom of the water, work progress pictures again would be in order. The little talk you made at your club would not only be more interesting because of the pictures you would show (probably by projection on a screen and perhaps in color) but your description would be made perfectly clear, even dramatic.

Progress on a lamp shade (2)

turing easier, relieve the strain on your vocal cords to quite an extent, make instantly clear subjects which otherwise might require much explanation, and generally make the work of the class run smoother. If you are a commercial demonstrator who must sometimes show how your product was made, all you need to do is make the pictures and caption them. Hardly any extra remarks will be required. If you wish to have a pictorial history of how you put together your rock garden, you will take pictures at each stage of the procedure from the very start. Such a history would make a grand record for your album and, if you felt so inclined, might even serve as the basis for an article for one of the garden magazines. If you have done an interesting job in your garden all garden lovers are an eager audience to hear you tell about it.

The accompanying illustrations show various steps in the making of photographic lamp shades. The pictures shown here are not consecutive or complete, but are intended merely to indicate the sort of things that work progress pictures are. You will notice that, since the principal objective is to show the details of the work, the subject in every case is either approached fairly



# A New PHOTO Contest

## OPEN TO ALL AMATEUR PHOTOGRAPHERS

## $150 IN PRIZES

### RULES OF THE CONTEST

1. Entries will be judged on the basis of pictorial appeal and technical excellence. The decision of the judges will be final. In case of a tie for any prize, duplicate prizes will be awarded to the tying contestants.

2. Prints must be no smaller than 3¼ by 4¼, but may be any size larger than these dimensions. Prints need not be mounted, but may be at the contestant's option.

3. Photographs must be submitted by first class mail, with sufficient cardboard to protect the prints.

4. Each entry must have the following data written on the back of the print or mount: Name and address of contestant, type of camera, and film used.

5. Prize-winning photographs will become the property of Scientific American, to be used in any manner at the discretion of the publisher

6. Scientific American reserves the right to purchase, at regular rates, any non-winning entry.

7. Non-winning entries can be returned *only* if sufficient postage is included when the prints are submitted.

8. No entries will be considered from professional photographers.

9. All entries in this contest must be in the hands of the judges by December 1, 1937. The results will be announced in our issue dated February, 1938.

10. This contest is open to all amateur photographers who are not in the employ of Scientific American.

**First Prize $75 · Second Prize $50 · Third Prize $25**

**Ten Honorable Mentions, Each to Receive a One-Year Subscription to Scientific American**

**See Last Month's Issue for Full Details**

Address All Entries to

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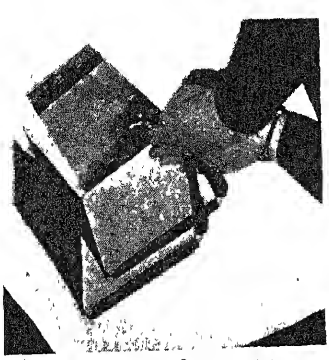
closely with a close-up lens or, where possible, taken at a more comfortable distance.

In work progress picture making, the "how" of the thing is the all-in-all. Light the subject so that all features of the particular step you are illustrating may be clearly seen



Progress on a lamp shade (4)

and perfectly understandable. Also, have your camera at the proper angle to obtain this result. The delayed action device with which most cameras are today equipped will serve you admirably on the occasions when you must be both subject and photographer.

After you have taken one or two series of work progress pictures you will probably think of pictures simultaneously with the project you have in mind. Camera and lights

## WANT TO SELL YOUR BERMUDA PICTURES?

HERE'S a market for you: The Little Syndicate, 597 Fifth Avenue, New York, N. Y. Pictures characteristic of Bermuda are being sought by this company with a cash offer for every picture found suitable and accepted. The syndicate's specifications for acceptable pictures call for the human-interest touch. If your Bermuda pictures answer this description to the satisfaction of the syndicate's powers-that-be, you're in the money.

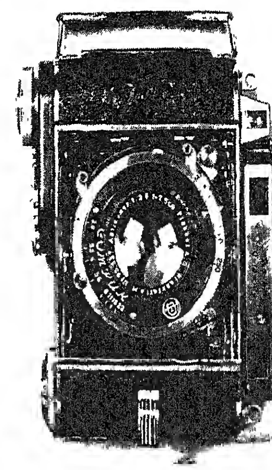
## HISTORICAL NOTE

THE discovery was recently made that, contrary to general knowledge, Matthew Brady, famous photographer of the Civil War, was not the first man to make war pictures, but that the credit in this regard really belongs to an unsung and unknown hero (or heroes) who took pictures of the Mexican War in 1847. The pictures were taken by the daguerreotype process and show American cavalrymen under General John Ellis Wool and a group of American infantry from a Virginia regiment on the Calle Real, a road through Mexico. The group, which includes scenes other than those of the Mexican War, comprises 12 daguerreotypes and belongs to H. Armour Smith, president of the Yonkers (N. Y.)

lent them to the Exhibition of Photography: 1839-1937, originally shown at the Museum of Modern Art, New York City, and now on tour throughout the country.

## PLAUBEL ROLLOP CAMERA

BACKED by the reputation of the makers of the famous Plaubel Makina II S, the Plaubel Rollop camera, equipped with the long popular Anticomar Anastigmat F:2.8 lens (3-inch focal length), has recently been made available in the United States. The Rollop, which is being distributed by Photo Utilities, Inc., is of the range-finder type, having a built-in Telemeter Range



**The new Plaubel Rollop**

Finder automatically coupled to the lens. The regular 8-exposure 120 roll of 2¼ by 3¼ film delivers 16 Rollop exposures. The shutter is the Rapid Compur delayed action type.

Measuring, when closed, 5 inches long, 4¼ inches wide and 1¾ inches through, and weighing only 26½ ounces, the Rollop is being welcomed by those who seek a camera that can be carried in the pocket for the chance shot that comes when one isn't looking for it. Besides the range finder, other automatic features of the Rollop are the automatic film exposure counting dial with automatic film wind stop, and its basic construction as a drop-bed, self-erecting-front folding camera.

The Rollop is of all-metal construction, with covering of grained black leather and trimmings in nickel and steel. The back, with spring pressure plate to keep film flat, swings by an end hinge. An ever-ready case is available.

## LEICA'S FOURTH EXHIBIT

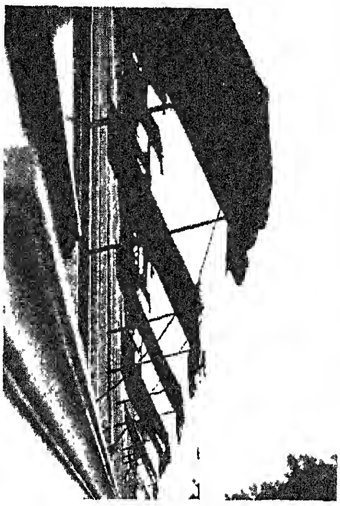
THE Fourth Annual Leica Exhibit, planned, as in previous years, to demonstrate advances achieved in photography through the medium of the Leica camera, is to be held in the fall of this year. While the date of the exhibit itself was not decided upon at the time of this writing, the closing date for the receipt of pictures was set for October 30. All users of the Leica camera are eligible to contribute as many pictures as they like. No entry fee is required.

The conditions are that pictures should not be smaller than 8 by 10 inches and may be sent unmounted. If mounted, they should

one of the following sizes: for 8 by 10 prints the mount size should be 13½ by 17 inches; for 11 by 14 prints, mounts 16 by 20 inches; for 16 by 20 prints, mounts 22 by 28 inches. While there are no restrictions as to subject matter, the sponsors are particularly anxious to receive action shots and sequence series. They would like to have, wherever possible, complete data relative to lens, film, aperture, shutter speed, filter (if any used), and so on.

## Serious Foreshortening

THE device of foreshortening is popularly used in pictures intended to be ludicrous, but there is a serious side to it as well. One possibility in this direction is illustrated in "Central Park West." The miniature camera used was tilted up from



"Central Park West"

an angle close to the corner of the building. With an opening of F:5.6 a fair degree of depth, at least sufficient for the purpose, was obtained. The angle gives the impression of space while at the same time suggesting the intimacy of home. Such unusual viewpoints are often encountered but it takes the camera and the studied angle to fix a picture of a sensation and a mood.

## Du Pont Film in Bulk

HITHERTO obtainable only in 36-exposure containers, Du Pont Superior (35mm), Micropan and Infra-D films may now be had in bulk rolls 27½ feet long, just the right amount for five 36-exposure loadings. Darkroom loading is facilitated by the fact that a leader already trimmed is found at the end of each 36-exposure length.

## Making Your Hobby Pay

FROM time to time we have mentioned in this department various new picture markets. We cannot urge too strongly that the amateur attempt to tackle these markets and see if he can't make them pay for a new camera or some of those expensive gadgets, not to speak of just humdrum necessities such as film and paper and chemicals. Good picture markets are the picture agencies who take your pictures on outright purchase or commission basis

magazines. If your pictures are good they can sell the same ones over and over again to various publications, whereas you might not be able to sell them even to one without knowing the ropes.

By studying the requirements of your local newspaper or the national magazines and submitting pictures now and then that you think seem to fit in, you will soon get the hang of the idea and with rejections will come wisdom, and sometimes a little note explaining the editor's needs.

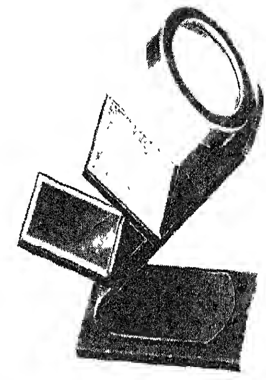
Don't overlook picture contests. Not only do the prizes pay you real dollars, but the mere fact that you have come out on top in a competition with many others will bolster your self-confidence as well as giving you wide recognition.

Another field is that of photographic magazines. They're springing up everywhere and they're looking for copy and pictures. If you are doing some photographic work exceptionally well or can write about some dark-room or picture-taking experience of yours that is unusual, they'll fairly eat it up and ask for more.

## Enlarging Focusing Device

MANY darkroom workers have had the experience, while working under the enlarger, of failing to get a sharp focus of the negative image on the easel. This may be due to density of the negative, the small aperture of the enlarging lens used, too weak a light source or even eye fogginess during a long processing session. Whatever the cause, this difficulty of focusing sharply often does occur. From time to time someone has beneficently come forward with a device to help the worker to overcome this problem.

The latest such device is called the See-Sharp Focusing Device, being marketed by R. P. Cargille. In use the See-Sharp, which consists of a metal stand and base, ground glass, mirror and magnifier, as shown in the illustration, is placed on the sensitized paper after the enlarger filter has been swung into place. The enlarger light is switched on and a mirror reflects to a ground-glass screen the image projected on the paper. The image on the See-Sharp screen is more brilliant than the image on the photographic paper because the screen is more efficient as a viewing surface than the paper; the image

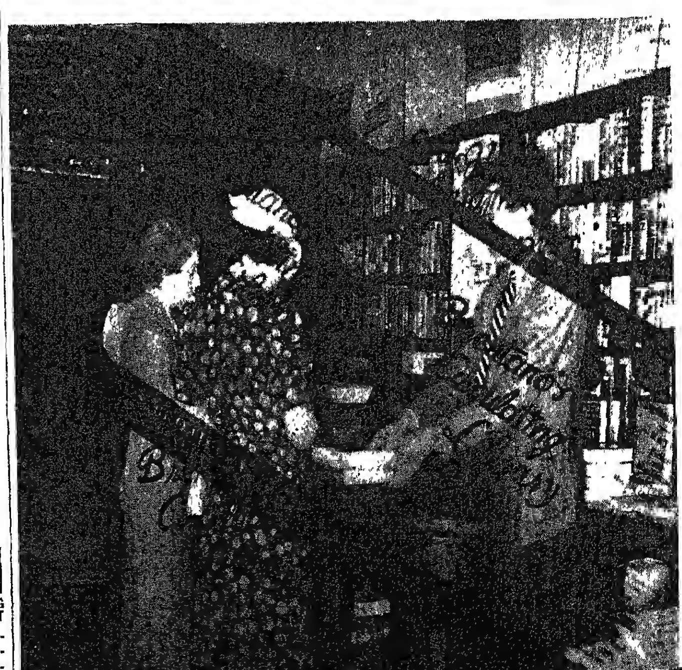


Precision for the enlarger

is viewed by transmitted light along the optical axis of the projector rather than by reflected light from the paper, and the See-Sharp exerts a selective action which discriminates against extraneous light such as that of the darkroom safelight. Furthermore, this brilliant image is magnified, thus greatly increasing visibility. The See-Sharp is only 2½ inches high and is viewed from the convenient working distance of about 24 inches.

## Windowless Window Effect

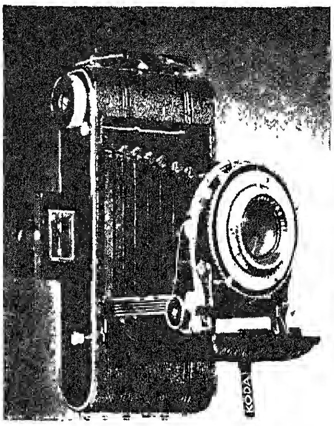
THIS apparent view through a window is not quite that, but the curious result of combining two negatives and printing them as one. One negative was a flash shot of the store view shown and the other was of a layout of three lending library book wrappers which were photographed in regular copying fashion. They were ar-



ranged on a flat surface, evenly lighted and shot head on. Had the exposure for the wrappers been fuller and the negative denser this transparency would have been greatly diminished. As it is, it gives the illusion of seeing the interior of the store through a window sign.

### Special Six-20

EQUIPPED with a Kodak Anastigmat F:4.5 lens and handsomely dressed up in bufted chromium and black lacquer, the Kodak Specials Six-16 and Six-20 are now available. The Specials take the popular



Special 6-20

2¼ by 3¼ or 2½ by 4¼-inch pictures, are equipped with Kodamatic shutters having speeds of 1/10, 1/25, 1/50, 1/100, and 1/200th of a second and a built-in delayed-action release that trips the shutter after a 10-second interval. Included also are a new optical direct-view eye-level finder and a new body shutter release as well as the regular trigger release. At a somewhat higher price the Specials may also be had with a Compur-Rapid shutter marked for 1 second, 1/2, 1/5, 1/10, 1/25, 1/50, 1/100, 1/200, and 1/400th of a second, as well as time and bulb action. These also have a built-in delayed-action timer.

### Steiner's Photofilm

MODELING his idea after the scenario used in making a motion picture, Ralph Steiner, well-known New York City Contax cameraman, has introduced what he believes to be a new phase for jaded camera fans to try their hands at. In a discussion of the idea, which he calls the Photofilm, in the July, 1937, issue of *Zeiss Magazine,* he declares: "There are still too many who spend a great amount of time taking the same old subjects in the same old way."

He defines the Photofilm as "a unified series carrying out an idea, feeling, or plot."

"Not just a number of random photographs of the same subject," he continues, "it is a progression of consecutive shots, each photographed on the basis of a planned scenario, and each made to fit into a definite place in the whole series, bearing a logical and visual relationship to the one before and following it. It is like a motion picture, except that each photograph takes the place of a scene, and there is naturally no motion. Due to the element of continuity the Photofilm arrests and holds the attention. Effort-

## THE SCIENTIFIC AMERICAN DIGEST

*(Continued from page 231)*

neers and the National Warm-air Heating and Air Conditioning Association.

This research was undertaken to determine the economics of residence cooling and to provide facts to show how homes could be cooled and air conditioned in summer at the most economical cost consistent with reasonable comfort to the occupants. It was intended to establish a basis for large-scale cooling of homes and to chart a course which the air-conditioning industry might be able to follow in broadening its market for year 'round air conditioning of residences.

Several different systems of cooling were tried out under actual operating conditions, including use of an ice-melting plant and mechanical refrigeration. The mechanical system proved least expensive to operate. When such systems were supplemented by the circulation of cool air from out of doors during the night, the investigators found that the cooling cost could be reduced by 23.4 percent, indicating an operating cost for a four months' season of $60.37 for a compressor-type system. Without the use of night air cooling, operating cost ranged from $254.89 for the ice plant to $78.65 for the electric compressor system.

The investigators emphasized that their data applied to conditions in Urbana, and were based on local costs for water, electricity, and ice. In their summary of conclusions, however, the investigators declared that a "mechanical refrigeration unit capable of producing 2½ tons of refrigeration is sufficient to maintain conditions of comfort in two stories of a residence similar to the Research Residence when outdoor temperatures do not exceed 103 degrees Fahrenheit."

Among other findings stressed in their report were that an indoor temperature of 80 degrees, Fahrenheit, with relative humidity below 55 percent "is satisfactory in the living quarters of a residence," but that for complete comfort in sleeping quarters "a somewhat lower temperature is desirable." The circulation of air from outdoors at night not only has considerable merit in reducing the seasonal cooling load that would otherwise be required, but "may make use of artificial cooling unnecessary for a considerable portion of the summer season," the report declared.

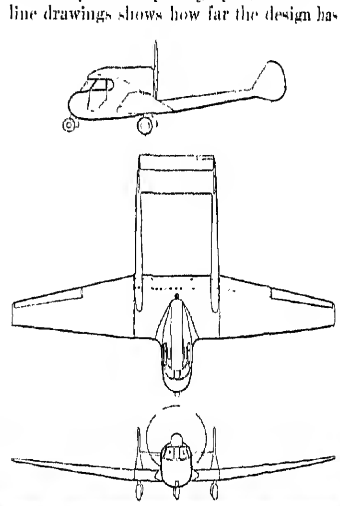
The tests also showed that the operating cost of the mechanical refrigerating system, when under continuous load, was 12.93 cents per hour, equivalent to 5.38 cents per ton of refrigeration delivered. Compared with this, the cost per ton of refrigeration delivered by the plant using ice as the cooling medium was 17.6 cents. During the period of tests, outdoor temperatures ranged from a minimum of 84.5 degrees to a maximum of 102.8 degrees.

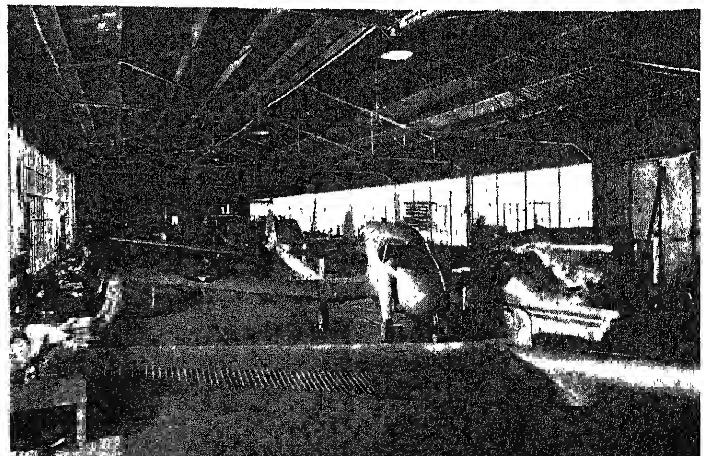
The researchers actually lived in the house to test personally their comfort reactions and to take the continuous readings that were necessary, but they did no cooking.—*Brewster S. Beach.*

## A Pusher in Production

IN these columns we have reported on the development of the modern private airplane of which a pusher engine and a fuselage nose-wheel are the distinctive features. The successful survival of these designs is the Hammond Y, now known as the Stearman-Hammond Model Y 125-M and in actual production (as one of our photographs shows) in California.

A study of this photograph and the outline drawings shows how far the design has





Interior of the plant where Stearman-Hammond Model Y 125-M planes are

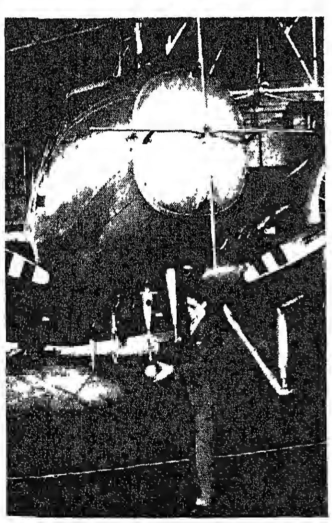
progressed, since its inception, in aerodynamic cleanness and efficiency while retaining the two essential features mentioned previously. The pusher arrangement gives perfect vision, particularly since the cabin is located forward of the wing, and it is no harder to enter the cabin than to step into an automobile. The three-wheel landing gear with the front wheel steerable has now definitely proved its value (as shown by its use on the huge Douglas transport, the *DC-4*) in providing stability on the ground, permitting landings in a wide range of attitudes, and allowing the brakes to be slammed on as hard as the pilot pleases without nosing over. The hydraulic struts of the Hammond landing gear now have a travel of 18 inches. As a result, the plane can land safely with a shock equivalent to a 6-foot drop. (We can imagine what would happen to an automobile if dropped through the same height!) Friends coming back from the West Coast tell us that the interior arrangements of the cabin are surprisingly like those of a luxurious automobile.

We have always considered the Hammond Y very promising and deplored solely its lack of speed. With the Menasco 4-cylinder, in-line, air-cooled engine of 125 horsepower, the maximum speed is now 120 miles per hour, which removes criticism on this score. We may expect a good many of these ships to be owned and flown privately.—*A. K.*

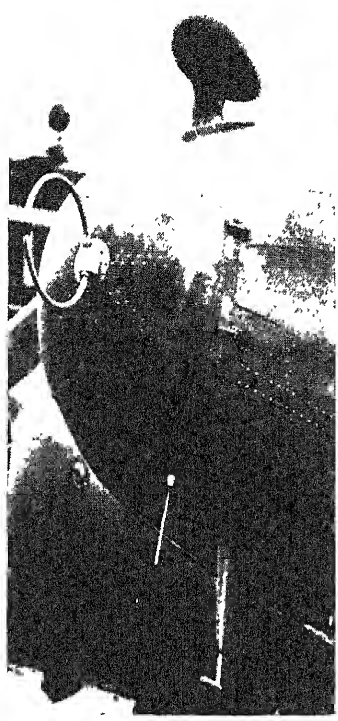
## Solving the Mystery of Aircraft Static

H. M. HUCKE, Superintendent of Communications Laboratory of United Air Lines, is a young man, as are most of the men building up air transport today, but he has done more to solve the mysteries of aircraft static than perhaps anyone else in the United States. His recent paper presented before the American Association for the Advancement of Science is a remarkable record of bold experiment and close reasoning.

Two types of static interference are normally experienced in aircraft radio reception. The first type consists of short, intermittent crashes which result from lightning flashes. The second type is classified as "snow static" although it is experienced when flying *at more than 100 miles an hour*



A variety of devices used in air-



The metal shielded nose antenna that has proved to be satisfactory

through clouds or any atmosphere containing ice crystals, rain, hail, snow, or dust particles. Snow static results from corona discharges on the plane itself and is recognized by a combination of noises like the frying of bacon, intermittent or regular crackling, and a peculiar musical "crying" which runs up and down the audible musical scale.

Snow static was first recognized as such in 1929 when radio equipment was first installed on transport airplanes. The first hypothesis was that the noise was due to the impinging of charged moisture particles on the metal antenna. But rubber or wood covered antennas did not cure the trouble, indicating this hypothesis to be in error. With Mr. Hucke as the guiding spirit, United Air Lines determined on a serious and thorough investigation, equipping a 10-passenger, twin-engined Boeing as a veritable flying electric laboratory, with a skilled, well rounded personnel.

The antenna masts, rivet heads, cotter keys on aileron hinges and tail wheels, the antennas themselves, and any sharp points on the plane are the focal points of corona discharges and consequently the source of snow static radio interference while in flight. Unless the discharge from these points is quieted, snow static cannot be eliminated. Covering them with an insulator, reducing their sharpness, or covering them with a well-rounded corona shield will only serve to build up a still higher potential until a corona starts at some other point.

There are two solutions open: To reduce the ability of the plane to gather charges; and to admit that the plane cannot be prevented from gathering charges and work out a means for discharging it which will not cause radio interference.

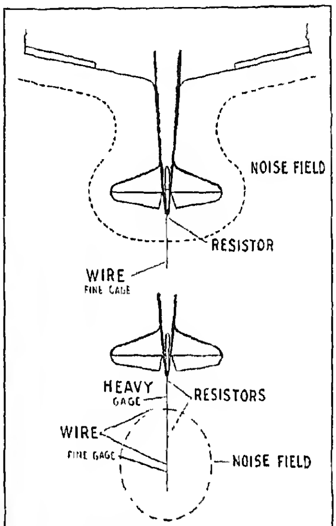
With the complexity of factors and variety of phenomena involved, Mr. Hucke concluded that the first solution was hardly within the realm of practicability. Therefore

While a complete solution of the difficulty has not been reached, some wonderful steps forward have been made, which may be summarized as follows:

It has been learned that snow-static interference is considerably worse at the rear of the plane than at the front. It is only under extreme conditions that static is equally distributed in all directions. Hence the use of nose antennas.

A wire antenna of the trailing type is the worst possible antenna to employ since it introduces interference and noise in the most effective manner.

While the theory that charged snow or rain particles striking the antenna produce static interference is totally discredited, there are definite advantages in using a circular loop antenna and shielding it completely with metal. While the true cause of




***Top:*** **Noise field (dotted lines) when static is discharged by a single wire and resistor.** ***Lower:*** **The field is pushed to the rear when a longer wire and two resistors are employed**

this advantage is not yet understood, the fact remains that there is an advantage. Accordingly, circular antennas with metallic shielding should be used.

Finally, Mr. Hucke has pointed the way to a fundamental remedy, which, while not yet in commercial form, seems to be very promising. The plan consists of reducing all sharp points on the plane, rounding off all rough edges on antenna structures, and, finally, causing an artificial voltage discharge through a trailing wire. When a wire of fine gage was mounted at the extreme edge of the plane, it gave an appreciable discharge but also produced a decided noise pattern or field all around the plane. When the conventional trailing wire was made longer and was placed in series with resistors, the noise field was diminished in intensity and thrown back clear of the airplane. With this arrangement a 1 milliampere discharge at 50 feet could be obtained with 100,000 volts without disturbance in the radio using the regular antenna. On the other hand, a 25 microampere discharge *without* suppressors from a point two feet from the plane prevented radio reception almost completely. These tests were made on the ground but flight tests have verified them.

A single trailing wire, properly disposed, means of discharging the static charge of a plane without interfering with radio reception.

Our readers will grasp immediately the full possibilities of this idea and wish Mr. Hucke and United Air Lines full success in further experimentation.—*A. K.*

## Ridiculously Low Bids

WELL informed authorities tell us that it is worth about 30 cents a mile to carry a 300-pound load of mail by air. What then is the explanation of the ridiculously low bids recently submitted by the airlines to the Post Office Department on the Washington to Buffalo route? The lowest bid—that of Pennsylvania-Central Air Lines of Pittsburgh—was at the rate of .00008 of a cent a mile for carrying 300 pounds of mail at high speed! To all intents and purposes Pennsylvania-Central was offering to carry the mail for nothing. The next lowest bidder—Transcontinental and Western Air—asked for 0.1 of a cent per mile, which again is so low as to mean gratuitous service.

One explanation of this ridiculously low bidding lies in the fact that an airline franchise today can be had only through an air-mail contract. Therefore operators resign themselves to carrying the mails for nothing so that they may secure the only sort of limited route certificate it is possible to obtain under the law.

Another explanation is that the operators realize that no fair treatment is to be expected from the Post Office Department anyhow, but that if they once obtain the contract, forthcoming legislation may transfer the control of rates to the I.C.C. from whom fairer treatment may be expected.

Still another guess is that the operators, long unfairly treated, are simply making a desperate gesture of defiance.—*A. K.*

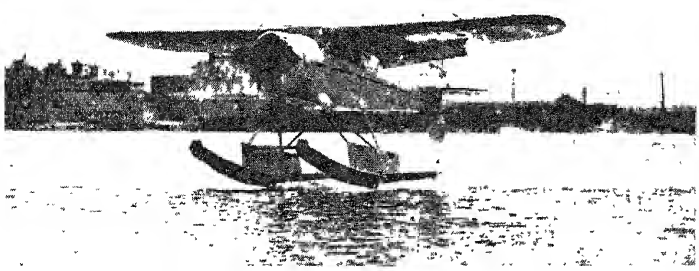
## Catapults for Transport Airplanes

THERE are rumors in well-informed quarters that somewhere in Indiana experiments in airplane landing and take-off are being undertaken with a moving track of the "caterpillar" or escalator variety. The entire track can be swung to face into the wind, and the airplane will land against the moving belt or will take off with its aid. Many authorities are also of the opinion that sooner or later catapults for both commercial land and seaplanes will be employed. The National Advisory Committee for Aeronautics is often content to follow the art and investigate *after* the inventor and the aviation industry have led the way. In the question of catapults, however, Langley Field is taking the lead, at least in cogitation and in presenting some striking calculations regarding their use.

The tendency for many years in air transport design has been to increase the loading per square foot of wing area. In the near future, we may expect wing loadings of 35 pounds per square foot, and a power loading of 10 pounds per horsepower.

With such a wing loading, the take-off run will be 4000 feet, which is excessive even for the largest airport. With the use of the controllable pitch propeller and flaps, the take-off distance may be reduced to 1800 feet, which is still too high.

Therefore, the Langley Field Conference



A plane on floats that may be interchanged with conventional wheels

acceleration only half that of gravity, so that passengers would not be at all disturbed. With this acceleration the take-off run would be reduced to 1150 feet, and the loading of 35 pounds per square foot of wing area would become entirely practicable.

The catapult would be located in the center of the airport in a pit below its surface, and mounted on a turntable so as to permit operation in any direction and to take advantage of the wind in get-away. For a machine the size of the four-engined DC-4, weighing 60,000 pounds, a catapult power unit of 3250 horsepower would be needed. Such a power unit would be expensive to install and expensive to operate. However, energy might be stored in a flywheel so as to secure the necessary accelerating thrust with a motor of relatively small size.—*A. K.*

**TRACTIVE EFFORT**

**THE average tractive effort of steam locomotives has increased 35 percent since 1920, but fuel consumption in freight service per 1000 gross ton-miles decreased 31 percent in the same period. In passenger service, fuel consumption per car-mile decreased 19 percent.**

## A New Argument for Airships

BEFORE the House Committee on Naval Affairs, Admiral W. D. Leahy said that the Navy had found airships "wanting," and advised against their further construction. Admiral Leahy's views probably represent those of the Navy as a whole. But the Bureau of Aeronautics, represented by Admiral A. B. Cook, its chief, and by Commander Charles E. Rosendahl, put up an excellent fight before the Committee and presented an entirely novel argument in favor of building a larger airship than any essayed to date.

When the *Akron* and the *Macon* were built, they were intended for scout duty. The big seaplane patrols have now grown in size, range, and speed to such an extent that in a very few years they will outclass the airship. Then why more airships?

One answer is that there are on the drawing boards designs of an airship of 10,000,000 cubic feet capacity which would carry aloft nine bombing planes of about 10,000 pounds each. The airship would then be classed as an aircraft carrier. It would cruise at 60 or 70 miles an hour, or more than twice the speed of the surface carrier, and have a comparable range of 15,000 miles. The airship plane carrier would have the planes at altitude, thus saving valuable time and fuel. Launched in the air, aircraft could be more heavily loaded and have a higher speed than when launched from the deck of the present aircraft carrier. True, the airship plane carrier would be vulnerable, but so is the surface carrier of today.

Certainly this is an argument worthy of consideration.—*A. K.*

## Putting Planes on Floats

AN association of private owners—amateur and professional pilots—with offices in New York City has just been formed to popularize water flying. Our cities and the Air Commerce Bureau are combining efforts in erecting municipal seaplane ramps on lake and river fronts. A privately owned large flying boat has made a transcontinental trip in a little over 17 hours. Yet another sign of the rising popularity of water flying is the rate at which all popular makes of land cabin planes are being equipped with seaplane floats, readily interchangeable with the ordinary landing gear. The accompanying photograph shows one of these well-known machines, the Cessna C-37, equipped with Edo floats, passing its A.T.C. Department of Commerce tests. It used to be thought that to equip cabin planes with floats would be a serious handicap to efficient operation in general, and the attainment of high speed in particular. The test figures contradict this view. The Cessna, powered with only a 145 horsepower Warner and carrying four occupants, has a cruising speed of 130 miles per hour, and a top of 140 miles. Take-off from glassy water is accomplished in 30 seconds. Gross weight is 2500 pounds; weight empty, 1595 pounds.—*A. K.*

## Koroseal Paper

THE most recent use developed for Koroseal, a synthetic elastic developed by the laboratories of The B. F. Goodrich Company, is its application to paper. This paper consists of a thin coating of pure Koroseal applied with strong adhesion to one side of a high-grade 40-pound kraft paper. It is suitable for any service where a water-proof, oil-proof, grease-proof, air-tight, or sanitary paper is required.

Because Koroseal is odorless, non-toxic, and non-tainting, this paper can be used in contact with foodstuffs, medicines, and other chemicals without fear of contamination. The Koroseal coating will flex as long as the paper does and will not crack. Addition of this tough film increases the tear resistance of the paper. Koroseal is less

attached, is not affected by sunlight, and will not oxidize.

Koroseal paper is recommended for packaging foodstuffs, chemicals, medicinals, oils, and so on, and can be used for making gaskets, shields, and flower pots or as a covering for heat insulation to exclude moisture. It has an over-all thickness of .006 to .0065 of an inch and in 40-inch width weighs .308 pounds per linear yard.

## Sheets in Five Groups

BECAUSE they do not know there are five distinct classes of cotton sheets on the market—all intended for different uses—most women are unable properly to compare prices and qualities. The Bureau of Home Economics recently analyzed 39 fairly representative sheets and grouped them as: Heavyweight muslin, mediumweight muslin, lightweight muslin, fine count, sometimes called "utility percale," and percale.

A percale sheet is a different material from the printed dress fabric called percale. It is the aristocrat of sheetings, the finest, smoothest, most beautiful, and usually most expensive. Percale sheets are light in weight, but are made of closely woven fine-combed yarns with a combined thread count of over 200 to the inch. They contain practically no sizing and wear well if used with reasonable care.

Heavyweight muslin sheets are chiefly used where they have extra hard wear as in institutions. The average homemaker wants a mediumweight muslin sheet. Those with a finished thread count ranging from 70 to 80 in the warp and from 61 to 70 in the filling are satisfactory for ordinary use.

In general, lightweight muslin sheets with a low thread count are coarse and sleazy when the sizing has washed out. They wrinkle under the sleeper, and are neither comfortable nor durable. Often they shrink unduly. On the other hand, very heavy sheets are cumbersome to handle and launder at home. If they go to a laundry to be washed by the pound they add to the bills.

In buying it is clearly impossible to compare a muslin sheet with a percale sheet on either a price or quality basis. Ruth O'Brien, in charge of the Bureau's textile research, believes it would be helpful to customers if manufacturers would establish minimum specifications for each of the five classes of sheets and put the classes on the labels. To be ideal, a label on a sheet should give thread count, breaking or tensile strength, weight, amount of sizing, length and width, and tell whether it is a first or a second.

## Colloidal Carbon—Acid or Base

COLLOIDAL carbon, the extremely fine carbon used in paints, inks, and for reinforcing rubber, may have the character of an acid or a base depending upon the method of its preparation. William B. Wiegand, of the Columbian Carbon Company, has found that colloidal carbons formed in highly reducing atmospheres (absence of oxygen) tend to be basic in character, while those formed in flames tend to be more acid. The reason for this is to be found in the amount of oxygen or its compounds adsorbed on the very minute parti- the acid or basic character, known as pH value, of the carbon but it is also related to its behavior in inks, paints, lacquers, and rubber compounds. Thus carbon, long considered a completely neutral element, has been shown to have decided basic or acid properties when divided into fine enough particles.—*D. H. K.*

**BUTTER FAT**

**ACCORDING to a survey in the *Journal of the Agricultural Association of China,* the butter fat standard of milk of Hangchow, China is 5.823 percent. The American Standard is 3.25 percent.**

## Quick New Pregnancy Test

A NEW, quick, and inexpensive test to determine whether a woman is going to become a mother is reported by Drs. John Huberman, Howard H. Israeloff and Benjamin Hymowitz of Newark, New Jersey. The test is made by injecting under the skin of the forearm one of the hormones present in the body of an expectant mother. If the skin becomes red and inflamed, the test is negative and the woman is not about to become a mother. If there is no reaction, the test is considered positive evidence that the woman is bearing a child.

The test was originally devised by Drs. C. C. Gilfillen and W. K. Gregg of Dayton, Ohio. The Newark physicians found it 90 percent accurate in tests of 200 expectant mothers and 95 percent accurate in 150 women known not to be expecting children. —*Science Service.*

## Two Rules of Science

"HEARSAY statements concerning events the causes of which were not ascertained, especially when made by credulous people with a mystical bent, though not necessarily devoid of truth, are always suspect. Science has carried all before it in virtue of two golden rules, the one, 'take no man's word for it,' the other to 'be economical in accordance with the Law of Parsimony that causes are not to be multiplied beyond mental necessity.'"—*Charles M. Beadnell, in Nature.*

## U. S. Oak Forests Have Great Potential Value

UPLAND oak forests of the United States are capable of heavier timber yields and are so strategically located with reference to centers of wood-using industries that farmers and other timberland owners should find it profitable to take better care of their stands, according to a recent study by the Forest Service, United States Department of Agriculture.

Comprising about 100 million acres or one fifth the commercial timber area in the United States, the upland oak region is mostly privately owned land lying largely in the upper Mississippi Valley and the central Appalachians. Existing stands in the upland oak region amount to about 43 billion cubic feet, or one third the total of all hardwood standing in the United States.

the merchantable stems on an average site is 47 cubic feet per acre, according to the study made by C. Luther Schnur, associate silviculturist of the Allegheny Forest Experiment Station—and although oaks do not grow as fast as many softwoods, stands 50 years old are apt to maintain very nearly their maximum growth until they are 100 years old. This long-term productivity is much in favor of the maintenance of hardwood stands, Mr. Schnur says.

Practically all the oak stands have been cut-over one to three times in a century, and only one third of a million acres of virgin stands remain. Curiously, the best stands of today are often found on charcoal areas, near the blast furnaces of many decades ago. The second-growth on these lands is now nearing its maximum production capacity. Mr. Schnur believes that most of the uplands, properly stocked and protected from forest fires, can be made to yield as well or perhaps better than these old charcoal areas.

Many of the oak forests have a large percentage of seedlings, which are superior to the sprouts in the long run. Five leading species of oak—white, black, scarlet, chestnut, and red oaks—constitute about 83 per cent of all the stands. In the East, the upland forests have suffered severely from the loss of chestnut, often associated with oak. It is believed that the loss of fast-growing chestnut, almost wiped out by a blight, has lowered the productivity as well as the present timber volume of many eastern forests.

## WIRE

**ALUMINUM wire so fine that 10,000 pieces laid side by side would measure only one inch in width is now being made for string galvanometers. A pound of this wire would cost you something over 150 million dollars although you can buy several pounds of pig aluminum for one dollar.**

## The New Insulin Insanity Treatment

MORE than 1000 mentally sick patients have been restored to health and sanity by treatment with insulin, diabetic remedy, according to Drs. Joseph Wortis and Karl M. Bowman of Bellevue Hospital, New York.

The treatment consists, essentially, of giving the mental patient enough insulin to produce shock. This is a much larger dose than is given to control diabetes, of course. The treatment was originated by a young Austrian physician, Dr. Manfred Sakel, in 1930. Since then, Dr. Wortis said, it has been used in 50 hospitals and universities throughout the world from Korea to Iceland and from Edinburgh to Galveston. The results are "substantially positive and confirmatory." Dr. Sakel claims that nearly three fourths of the patients who have been ill less than six months recover completely, while good results are obtained with slightly less than half of those who have been ill several years.

The particular disease for which insulin shock is used is schizophrenia. No one ment may give the clue on further study. Results from this treatment already show that the cause is probably organic; that is, it seems to be a defect in brain structure or chemistry, and not mental or psychologic, as some psychiatrists have held.

The treatment of this disease, also called dementia praecox, by insulin shock, produces improvement that outruns anything produced by any other kind of treatment, in the opinion of Drs. Roy G. Hoskins and D. Ewen Cameron, Worcester, Massachusetts, State Hospital. These two physicians were the first to take up the insulin shock treatment of schizophrenia in the United States. They and the Bellevue doctors both reported their results, discussed various points in technique, and warned that the treatment must be given only in a well-equipped hospital under the supervision of a trained psychiatrist ready to meet the dangerous emergencies which may arise. Chief of these is the possibility of the patient succumbing to the shock unless proper restorative measures are at once instituted. —*Science Service.*

## Soaping Oil Wells

BY pumping a strong solution of soap down an oil well the leakage of water into it through porous sand is prevented, according to a newly patented process. The effectiveness of soap for this purpose depends on the fact that the water normally leaking into a well is hard and forms a sticky precipitate with the soap. This precipitate plugs up the tiny openings through which water gets in. Since oil does not react with the soap solution the seepage of oil is not disturbed. By thus preventing the leakage of water into producing wells the cost of pumping is reduced and the yield of oil increased.—*D. H. K.*

## There are Vacuums, and Vacuums

BEYOND the extremes of the earth's atmosphere is an almost perfect vacuum. In between the stars, which occupy only about one billion-billion-billionth part of space, we find a few meteors, some cosmic dust, and a small number of atoms. The investigation and analysis of this rarefied inter-stellar gas is obviously not a simple matter. Imagine, if you can, a tube one foot in diameter and 50 million million miles in length. Such a tube would extend approximately from the earth to Sirius, a distance of about nine light-years. According to actual measurement, the density of inter-stellar gas is so low that in this entire great tube would be found only one tenth of a gram of substance, just about the equivalent of the air in your ink bottle (the density is about one hundred million times smaller than that of the best vacuum producible on earth).—*The Telescope (Cambridge, Massachusetts.)*

## Welding in Steel Building Construction

A NEW building code, which becomes effective on January 1, 1938, has been adopted by New York City. Among other provisions in keeping with recent progress in the building industry, the new code spe-

of riveting, in the construction of steel buildings, a process heretofore barred in New York because the present code was drawn up before this process was developed.

This action on the part of New York removes the last serious obstacle to the general use of welding in building construction. Elsewhere throughout the United States and in all foreign countries, the welding of buildings has been permitted either by specific code provisions or by special authorization. As New York's new code is the result of several years of hard work by many distinguished architects, engineers, and other specialists in the building field, it will doubtless serve as a model for other cities where codes have become antiquated. Hence, New York's approval of welded buildings may be considered the last word in the discussion of this new engineering technique, which began 17 years ago when the world's first welded building was erected.

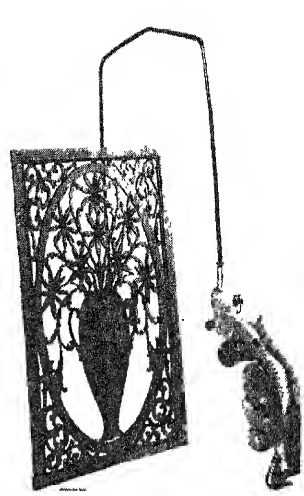
From the standpoint of the public, the most interesting feature of welding for building construction is its noiselessness. The rattle of the pneumatic riveter, which interrupts conversation and racks the nerves of everyone for blocks around, is eliminated. Silent steel construction will be a novelty for New Yorkers, and doubtless they will appreciate it.

From the standpoint of the engineer, the chief advantages of welding are that it makes possible lighter, stiffer, and more compact joints, and often effects a considerable saving in the amount of steel required.

## Hot Wire Scroll Saw

INSTEAD of cutting with a saw blade, a new artcraft scroll saw cuts with a heated element which is reciprocated lightly across the wood. The heated element consists of a wire held in a spring frame to which is attached a pistol grip with trigger switch. Electricity is supplied by a specially wound transformer which lowers the voltage of the household circuit (which must be 110 volts AC) and raises the current. The operator cannot receive a shock.

This new equipment, which is called the Electric Pyro-Cut Saw and is manufactured by the E. L. Meyer Company, is simple to operate and is practically noiseless. The hot



Close-up of the saw, showing the fine wire that burns through wood

wire leaves a black finish to the cut edges and there is no sawdust or muss of any kind. Also there is no chipping or splitting of wood when the job is almost finished. A special motor-driven smoke eliminator is included with this outfit.

## Food and Rest as TB Preventives

THE importance of seeing that children get enough food and rest as one way of protecting them from tuberculosis is often overlooked, Dr. Ralph M. Tyson of Philadelphia has emphasized in a discussion of childhood tuberculosis which was reported by *Science Service*. Physical examinations, including tuberculin tests, must be made on all school children if childhood tuberculosis is to be eliminated, Dr. Tyson said.

"Long hours in badly ventilated classrooms and college lecture halls, in stores and work rooms, together with a lack of recreation, irregular meals of poor quality and insufficient quantity, and insanitary living in general are mainly responsible for the spread of tuberculosis in the adolescent," he declared. Difficult as it is to restrict the activities of growing children, it helps materially in the prevention of tuberculosis.

Tuberculosis caused by infected milk, he reported, is becoming rare as a result of inspection and testing of dairy cattle and the pasteurizing and boiling of all milk.

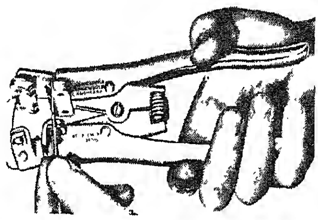
## Strip Wire With a Squeeze of the Hand

THERE has been a persistent demand for a simple hand-operated wire stripper that will grip and remove the insulation to lay bare the tip of the copper wire all in one operation. Such a device is now available in the new E-Z wire stripper made by the Pyramid Products Company.

One jaw of the working head of this ingenious device clamps the end of the wire in a strong grip when pressure is applied to the handles. Increasing the pressure causes the two grooved blades of the other jaw to bite into the insulation while one of the grooves surrounds but does not cut

ning the piece of cut insulation completely off the wire. The details of this are shown in the accompanying illustration.

This instrument is made to handle wires of various size. For 20 to 30 gage wire, it



*Stripping wire clean*

has six stripping holes; from 12 to 18 gage, three stripping holes; from 10 to 16 gage, three stripping holes; and for 8 to 14 gage, two stripping holes.

POISON

THE neurotoxin from the venom of the South African cobra is so poisonous that two grams could kill a million mice. This poison has just been extracted in pure form by Dr. F. Micheel of Göttingen University.

## Stick-To-It-Iveness in Sand Paper

TO overcome failures of sand paper and other coated abrasives, new methods have been devised to improve the bond between the adhesive and grit used. These treatments, of which several are used, consist of etching the smooth surfaces of the grit with chemical reagents to roughen them, various types of heat treatment, and the production on the grain surface of adherent coatings of other material to which the adhesive bonds tightly. By such preliminary treatments the abrasive particles are held more tightly to the backing, thus giving the combination a longer useful life. In the modern industry of sand paper, garnet, emery and the synthetic abrasives, silicon carbide, aluminum oxide and boron carbide, largely replace sand (flint), and paper has given way to cloth and vulcanized fiber so that it is scarcely proper to speak of the product of the modern industry as sand paper. Coated abrasives are made in a variety of finenesses from two or three particles per square inch to as many as 100,000.—*D. H. K.*

## Fog-Proof Goggles

FOR years inventors have attempted to develop fog-proof goggles that could be worn under water. The main trouble has been that where goggles are made air- or water-tight, the body heat on the inside of the goggle and cold water on the outside causes such a dense fog to form that the swimmer is instantly blinded.

H. S. Cover has designed a goggle that overcomes this difficulty. Heavy glass lenses are mounted in a rubber frame and fastened with an elastic band at the back of the head. Just enough tension is brought to bear to mold the goggles to the contour of the face and make them water-tight. At a

groove has been provided. A few drops of water placed in this groove before the swimmer puts on his goggles is sufficient to absorb any excess moisture and keep the goggles from clouding over. As swimming movements are executed, the water placed in the rubber groove is agitated across the goggle lenses, removing fog as fast as it forms. In some cases where swimming movement is not active enough to remove the fog, a slight nod or shake of the head will do the trick.

With these goggles it is possible for under-water swimmers to study subterranean plant life and shell or rock formations.

## Prontosil Combats Germs in Variety of Diseases

PRONTOSIL, a new chemical remedy that has already saved thousands of lives and promises to conquer four of mankind's major germ enemies, held the spotlight at the most recent meeting of the American Medical Association. This red dye and its chemical relative, sulfanilamide, were the most important and most talked-of subjects on the program and around the convention hall in Atlantic City.

The latest disease to go down before the attack of sulfanilamide is pyelitis, a serious and troublesome urinary tract infection for which there has hitherto been no very successful treatment. Cases of pyelitis which were completely cleared up by treatment with sulfanilamide were reported by Dr. Henry F. Helmholz of the Mayo Clinic, Rochester, Minnesota. This was the first report of the use of the new chemical remedy for this disease.

The chemical is not an antiseptic and does not kill the disease germs. Its action apparently is to keep the germs from growing and multiplying in the patient's body. The body's own fighting forces are consequently able to overcome the infection, and the patient recovers.—*Science Service.*

## Permanganate in Fertilizer

ADDITION of potassium permanganate in small amounts to fertilizers has been found in England to increase the yields of radishes, lettuce, and other vegetables. It also has the effect of removing moss and earthworms from lawns, which suggests its use on the greens of golf courses. Presumably one of the effects of this powerful oxidizing agent is to convert organic nitrogen to nitrates in the soil as well as to supply small amounts of manganese sometimes deficient in the soil.—*D. H. K.*

## Speed of Fox

HOW fast can a fox run?

On a South Carolina road last winter, a gray fox answered the question with a burst of speed at the rate of 26 miles an hour for about 100 yards, gradually slowing to a speed of about 21 miles an hour at the end of a half mile.

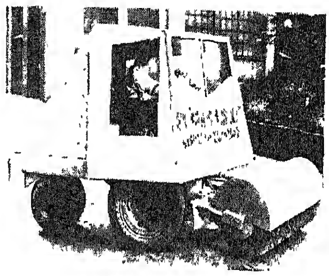
Clarence Cottam, of the Bureau of Biological Survey, was inspecting wildlife areas in the Southeast when the fox jumped phases of wildlife, tooted the horn to encourage the fox to extend himself, and, watching the speedometer, followed close.

How does the speed of this fox compare with the best efforts by men? Sprinting at 26 miles an hour the fox went the first hundred yards in a shade less than eight seconds. The world record for the 100-yard dash is 9.4 seconds. At 21 miles an hour the fox would go half a mile in a little less than one minute and 26 seconds. The fastest half mile by a man is just under 1 minute 50 seconds.

## "La Cucaracha," the Street Sweeper

AMERICA is now shipping "cockroaches" to South America.

However, these are not the pesky little bugs that swarm around water-pipes and get



"La Cucaracha"

into all sorts of places where they shouldn't be, but a new and unusual type of street-sweeper that the Argentines have nicknamed "La Cucaracha" which means, as everyone knows who has heard the lilting song of that name, "The Cockroach."

A large fleet of these busy little vehicles has just been shipped to the "Municipalidad de Vicente Lopez, Administration de Limpeza," which is a suburb of Buenos Aires, Argentine Republic, by a Cleveland manufacturer.

"La Cucaracha" is so light that it can be used on sidewalks as well as on streets or other paved areas, which heavier machines might break through. The lightness of the machine itself and the softness of its General streamline Jumbo, Jr. pneumatic tires, however, prevent any damage to sidewalks or pavements. Divided among six tires, the weight is less than 700 pounds on each tire.

All controls on "La Cucaracha" are inside the cab, and the motor, transmission, and rear driving axle, or differential gearing, are standard 1937 Chevrolet ton and a half truck parts. There are eight speeds on the broom and four speeds on the machine and it has a turning radius of only 78 inches; it sweeps a path 60 inches wide.

## Fire-Walking: Nothing Abnormal Involved

SOME two years ago, the University of London Council for Psychical Investigation arranged a demonstration of fire-walking, with the view of obtaining precise information upon its scientific aspects. Descriptions of the condition of the feet of the performer, Kuda Bux, before and after the walk, and results of some physical observations, were given in *Nature* of September 21 and 28, 1935. As the observations were not altogether conclusive, two more demonstrations were arranged by the Uni-

vestigation through Mr. Harry Price, honorary secretary of the Council, in the grounds of Mr. Alex Dribbell at Carshalton, Surrey, on April 8 and 10, 1936.

The professional fire-walker was Ahmed Hussain, a Moslem from Cawnpore. In the first experiment, the trench containing the charcoal on oak-ash was 12 feet long. The temperatures were measured by special thermocouples with the co-operation of the Cambridge Scientific Instrument Co., Ltd., and were shown to be 575 degrees, Centigrade, on the surface and 700 degrees, Centigrade, inside. After examination and tests for chemical treatment, Hussain walked the trench in 1.3 seconds, showing no signs of injury. He then repeated the walk leading three amateur volunteers with the claim that they would be immune from burning. They were, however, all burned to a varying but slight degree. A further two volunteers then performed the walk separately and unaided. They were also slightly burned, and where the number of steps had been uneven, the foot that had been down most often was most affected. This indicated that the injurious effect was cumulative, although Hussain claimed that he could walk any distance. As he refused to retrace his steps, the trench was increased to 20 feet for the second experiment.

In the second experiment, the surface temperature was 740 degrees, Centigrade, and the inside 750 degrees, Centigrade. Hussain took six steps in 2.3 seconds, and this produced five blisters on one foot and marked erythema on the other, a condition closely resembling that of the amateurs after four steps. The effect was therefore cumulative in his case also. One of the former volunteers covered the distance in four steps and 1.4 seconds, and then later, in rope-soled shoes, took seven steps in 3.6 seconds. The frayed portions of the rope were slightly scorched at the edges only. The feet sank into the ash to a depth of between two and three inches, and it seems clear that its poor thermal conductivity prevents damage to normal skin if the contact-time is less than about half a second, although the small flames within it will produce singeing of the hairs. This time corresponds with that of one quick step: two steps with the same foot could only be done without injury by the practiced professional, and three steps was beyond his limit.

This small difference between amateur and professional, together with observations made during the experiment, make it very unlikely that any hypothesis of a special induced mental state is required, such as is, of course, maintained by the Indian performers.—*Nature* (London).

## New Burn Treatment

SUCCESSFUL treatment of burns (when not too serious) by the use of amyl acetate to which methyl tertiary butyl phenols are added as antiseptics has been reported in the *British Medical Journal.* Amyl acetate is a commonly used solvent for nitrocellulose in lacquers and goes by the common name "banana oil." This solvent is said to reduce the pain of the burn by its analgesic action. Since it is not antiseptic, a germicide must be added. The treatment is described as consisting of remoistening dressings at intervals.

## Microbes in Paper Manufacture

BECAUSE pulp, the intermediate product in the manufacture of paper, makes a desirable environment for the growth of micro-organisms, a wide variety of these are to be found in the products of the paper mills. These not only affect the quality of the paper produced but in some cases may even remain in the finished product or leave undesirable flavors and odors in it. By recognizing this fact, paper makers are able not only to improve their product, but at the same time to provide material for food containers which is sterile and odorless. Chlorine and copper sulfate used with discretion are the most effective germicides for the purpose.—*D. H. K.*



# CURRENT BULLETIN BRIEFS

*(Bulletins listed as being obtainable through Scientific American can be supplied only by mail)*

RADIO TRANSCEIVER BULLETIN describes a new type of crystal-controlled outfit which has been designed for 5 and 10 meter mobile phone and 20-40 meter continuous wave operation. *The Radiotransceiver Laboratories, 8627 115th Street, Richmond Hill, N. Y.—Gratis.*

A NEW SPECIES OF DEEP-SEA FISH, ARGYROPELECUS ANTRORSOSPINUS, OF THE FAMILY STERNOPTICHIDAE is a typical scientific description of a new species of animal with a long name. *The Smithsonian Institution, Washington, D. C.—10 cents.*

HEAT TREATMENT FUNDAMENTALS is Section 3 No. 7 of "Nickel Cast Iron Data." It covers nickel cast iron, plain cast iron, nickel-chromium cast iron, and nickel-chromium-molybdenum cast iron, giving a vast amount of engineering data on the handling of these various alloys. It ... ber of charts. *The International Nickel Company, Inc., 67 Wall Street, New York City.—Gratis.*

PRACTICAL SPEEDS OF FILMS AND PLATES, compiled by Photo Utilities, Inc., is a handy guide to the perplexed film and plate user. The booklet embodies a fairly complete listing of the products of all the best known emulsion manufacturers arranged by style of film packing, such as ciné film, roll film, cut film, and so on, and giving the light speed, or sensitivity, of each emulsion by daylight and by artificial light. The system of rating used is that of Photoscop Speed Numbers, which corresponds numerically to that of the Scheiner system as employed in the United States. The tables, which also include a section devoted to color processes at present on the market, were compiled after consultation with manufacturers whose reports, checked by prac-

the compilers in contact with thousands of exposure meter users, constitute a booklet only 2½ by 3¼ inches, fitting snugly into the vest pocket. *Service Department, Photo Utilities, Inc., 10 West 33rd Street, New York, N. Y.—25 cents per copy.*

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BUILDING BETTER PIPE LINES FASTER AT LESS COST BY SHIELDED-ARC WELDING is a 14-page pamphlet profusely illustrated with photographs of pipe lines under construction. It includes a short explanation of the modern shielded arc process of electric welding, together with a summary of tests of pipe welds made by this process. Data is given in tabular form on important aspects of welding of pipe lines. *The Lincoln Electric Company, Cleveland, Ohio.—Gratis.*

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SYNTHETICS BRING NEW ERA IN PERFUMES is a 16-page booklet that describes the making of perfumes, synthetic perfumes in soaps and cosmetics, and perfumes used in industrial products and processes. The last-mentioned is a most important usage, as it is employed to cover up objectionable odors in a multitude of items. *Write for Bulletin 1037A, Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

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WEATHERING RESISTANCE OF CONCRETE, by E. J. Kilcawley, C. E., is a report of a series of tests on three inch by six inch cylinders of concrete of various compositions, extending over a total period of 720 days. The data and facts presented will be of interest to every user of concrete. *Rensselaer Polytechnic Institute, Department of Civil Engineering, Troy Building, Troy, N. Y.—Gratis.*

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THE ARCHEOLOGY OF PLEISTOCENE LAKE MOHAVE is a detailed, illustrated symposium on the artifacts found in the dried up bed of a glacial-age lake in the Mohave Desert, together with the geology. These artifacts may be as much as 15,000 years old. *The Southwest Museum, Highland Park, Los Angeles, California.—$1.75.*

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TWIN POCKET TROUBLE SHOOTER GADGETS, devised by Alfred A. Ghirardi, are two novel compilations of data for the radio trouble shooter, covering both home and automobile radio sets. These gadgets are fully described in a circular which may be had by writing for Bulletin G35, *Radio & Technical Publishing Co., 45 Astor Place, New York City.—Gratis.*

---

ARC WELDED DESIGN is the title of a large single sheet chart which gives concise information on weld symbols for working drawings, instructions for use of welding symbols, nomenclature of welds, types of joints for arc welding, and tables covering electrode metals for hard facing, properties of base and weld metals, length of fillet weld to replace rivets, and safe allowable loads for fillet welds. The chart can be oiled and blueprinted. *Write for Bulletin 1037B, Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

---

HILLIARD OVER-RUNNING CLUTCHES explains the mechanical details of this particular line of over-running clutches. Engineering

These clutches give the same effect as "free wheeling" in an automobile, and can also be used in dual drives as well as providing an excellent ratchet application capable of infinite adjustments, and a positive backstop for conveyors, elevators, and so on. *The Hilliard Corporation, Elmira, N. Y.—Gratis.*

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OPERATORS HANDBOOK gives in compact and convenient form new and up-to-date information on tires, which will be valuable to owners and operators of trucks, buses, tractors, or farm implements, and industrial equipment on which rubber tires are used. Complete descriptions are given of tires and tubes for such uses, including detailed data on each type, as well as a calculator which makes it possible to arrive at actual truck tire costs. The chapter "Load Ratings and Inflation Pressures" gives much new information. *Write for Bulletin 1037C, Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

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PLASTICS is the title of a new monthly publication which deals specifically with the manufacture, uses, and potentialities of such plastic materials as synthetic resins, casein, rubber, and cellulose compositions. The magazine is presented in an attractive format 9¼ by 12½ inches, and includes color plates as well as attractive half-tone illustrations. *Temple Press Limited, 5-17 Rosebery Avenue, London, E. C. 1, England. —Subscription price 15/- (international money order) per year in United States.*

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THE USE OF IOWA COAL IN DOMESTIC STOKERS, by M. P. Cleghorn and R. J. Helfinstine, gives the results of tests recently made to determine whether the most valuable of the natural resources of Iowa can satisfactorily be employed in domestic stoking units. The method of conducting the tests and the results obtained are given in detail. *Bulletin 134, The Director, Iowa Engineering Experiment Station, Iowa State College, Ames, Iowa.—Gratis.*

---

WINTER RADIO CATALOG gives in 180 page a complete listing of home, farm, a automobile radio sets, public address equi ment, "ham" apparatus, replacement part tubes, test equipment, and a complete lin of electrical appliances. *Write for Bulletin 1037D, Scientific American, 24 West 40t Street, New York City.—3-cent stamp.*

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THE EFFECT OF CITY WATER AND SEWE FACILITIES ON THE MARKET FOR CONDITIONING EQUIPMENT is a report pared by the Bureau of Foreign and Domestic Commerce to make available a factual survey of possible water supplies in metropolitan centers of the United States. The report contains data on raw water supplies delivery capacity, possible expansion, tem perature data, and so on. *Bureau of Foreign and Domestic Commerce, Washington, D C.—10 cents (coin).*

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TEA, by Llewelyn Williams, Botany Leafl 21, is a survey of the growth, classific tion, cultivation, and processing of tea in the Orient. It is illustrated with a series of photographs and is as interesting to the lay reader as to the person specifically interest

# LEGAL HIGH-LIGHTS

## Patent, Trade Mark, and Related Legal Proceedings That May Have a Direct Effect on Your Business

By ORSON D. MUNN, Litt.B., LL.B., Sc.D.
New York Bar
Editor, Scientific American

### HAMBURGER CASTLES

THOSE white roadside lunch rooms, designed like miniature castles, which specialize in Hamburger sandwiches, have recently been the center of litigation based upon unfair competition. The proprietors of two competing chains of lunch rooms of this character filed cross suits charging that the names, types of buildings, and advertising slogans were so similar as to mislead and deceive the public. The stands of one of the proprietors were known by the name "White Castle" and the slogan was "Buy 'em by the Sack." The stands of the other proprietor were known by the name "White Tower" and the slogan was "Take Home a Bagful." The "White Castle" lunch rooms began business prior to the "White Tower," the former having started in Wichita, Kansas, in 1921, and the latter being organized in Milwaukee, Wisconsin, in 1926. The storm center of the controversy was Detroit, and it appeared that even though the "White Tower" lunch rooms were the last to organize they were the first in the Detroit market. The "White Tower" lunch rooms commenced business in Detroit in 1928, while the "White Castle" lunch rooms entered Detroit in 1929.

It was contended by the proprietor of the "White Tower" lunch rooms that since they were the first to operate in Detroit the "White Castle" lunch rooms should be enjoined at least in that territory. The proprietor of the "White Castle" chain, on the other hand, contended that since the "White Castle" lunch rooms were the first to operate in any territory they were entitled to injunctive relief against the "White Tower" lunch rooms. The court rejected the contention of the proprietor of the "White Tower" lunch rooms and sustained the contention of the proprietor of the "White Castle" chain, granting an injunction against the acts of unfair competition which the proprietor of the "White Castle" chain complained of.

Some very fundamental questions of the law of unfair competition were discussed in this case. Thus, it was contended by the proprietor of the "White Tower" chain that where a second party has innocently adopted a name which has already been used by another and builds up a business in a market remote from that of the first user, the second party may not be restrained in his use of the name in that market. Based upon this principle of law, it was contended that since the "White Tower" lunch rooms were the first to do business in Detroit, their rights, at least in Detroit, were paramount. The court found, in the first place, that the "White Castle" lunch rooms were already ways and the general public was familiar with them. The court also rejected the contention that the "White Tower" lunch rooms had innocently adopted their name, slogan, and system of doing business but on the contrary found that the peculiar characteristics of the "White Castle" lunch rooms were deliberately imitated.

### SCIENTIFIC DISCOVERIES

A SCIENTIFIC discovery as distinguished from an invention, generally speaking, is not patentable. Thus, where a scientist, as a result of research, discovers the scientific explanation of certain natural phenomena, he cannot protect his discovery by means of a patent. In a recent case before the United States Court of Customs and Patent Appeals involving a patent application on a motor fuel and the process for making the same, the Court found that the applicant for the patent had merely discovered the explanation for certain natural reactions, and sustained the refusal of the Examiner to grant a patent. The Court stated:

"As a result of the researches of the applicant, an explanation has been made of certain natural reactions which have been known to the art to occur, but which were imperfectly understood. This does not, however, amount to invention."

### ALIEN ENEMY

THE patent laws provide that a patent cannot be obtained on an invention which has been in public use in the United States more than two years prior to the filing of a patent application. A patent which is granted on an invention which has been in public use for more than two years in the United States is invalid.

In a recent case a patentee claimed exemption from this provision of the patent laws on a rather novel theory. The patentee found himself between the horns of a dilemma. He had brought a suit charging patent infringement and the defendant in the suit claimed that the patent was invalid because of an earlier patent disclosing the same invention. The patentee then introduced evidence purporting to show that he actually made the invention prior to the earlier patent and his evidence made it appear that he had placed the invention in public use more than two years prior to the filing of his application. The patentee sought to avoid the provisions of the statute referred to above by stating that he was an alien enemy of the country at the time and that his delay should be excused. Since the

"The plaintiff also seems to have in mind that some of his own difficulties might change the law in that regard and let him wait more than the two years. He mentions in that connection that he was in law an alien enemy of the country, and that this explains in some way his delay. * * * I don't know of anything in the law that would treat those things as excuses or justification for any setting aside of the two-year rule."

### RESTRICTED NAME

WE pointed out on this page in the February, 1937, issue of Scientific American, under the heading "Whose Name?", that your right to use your own name in business is not free from restrictions where there is danger of confusion between your name and a competitor of the same name who had used his name in his business at an earlier date. Under the restrictions imposed by this principle of the law of unfair competition an individual may use his name in business in one neighborhood and may be barred from using it in another neighborhood. Thus, in a recent case in New York a woman was engaged in the millinery business on Broadway. Another woman bearing the same surname subsequently opened a millinery store in the same neighborhood. The newcomer was enjoined by the court from using her name in connection with the retail millinery business on Broadway in New York City between 80th and 102nd Streets.

### FOREIGN PATENTS

A DISTINGUISHED correspondent from abroad has sent us a suggestion which we think is worthy of the serious consideration of our readers.

The patent laws of many foreign countries contain so-called "working" requirements. Under these requirements it is necessary for a patentee to manufacture the patented device in the country in which the patent is granted, within a period of two or three years. Failure to comply with the working requirements might result either in the cancellation of the patent or the granting of a compulsory license for the manufacture of the device.

It will be readily appreciated that where a manufacturer has obtained a patent in a foreign country having a very small population it would be impractical, due to the limited size of the market, to establish a factory for the purpose of manufacturing the patented device in that country. In many instances the principal advantage received by an American manufacturer from foreign patents is found in the enlarged protected market which he obtains for the patented products of his American factory. If under the working provisions of foreign patent laws he is deprived of the enlarged protected market, the advantage obtained from the foreign patent is destroyed.

Our correspondent has suggested that by treaty between the United States and those countries having working requirements, American citizens could be protected by providing that manufacturing in the United States within the prescribed time was sufficient compliance with the working requirements. That such a treaty is practical is evidenced by the fact that one already exists between the United States and

# Books SELECTED BY THE EDITORS

## EVERY MAN A MILLIONAIRE

*By David Dunham*

A GENIUS (or a crazy man) by the name of David Dunham is the hero of this crazy-quilt of inventions which revolutionize the entire world and give to David Dunham dividends amounting to a great many billions of dollars per year. David Dunham serves an ultimatum on Europe that if the second World War is not immediately stopped and seven billion dollars paid to the United States, the United States will forthwith use David Dunham's scheme of diverting the Gulf Stream so that Europe will freeze. David Dunham invents a new rotary razor, the touch of which feels so much like velvet on the face that men begin shaving three or four times a day, and all wars are immediately forgotten, for men have no time to stop the pleasure of shaving for such petty things as wars. Men use hair tonic on their faces so that they may shave oftener! David Dunham builds, in the Sahara, high towers which become snow-capped like mountains, cool the atmosphere, and do a lot of other things meteorologically, so that the desert is made to bloom and David Dunham takes a mere 64 billion dollars profit per year from the scheme. David Dunham has, in fact, written in this small volume of just under 100 pages, the details of 37 gigantic David Dunham schemes, developed by David Dunham to make a David Dunham world scientifically most perfect and financially most profitable to David Dunham. In fact, we believe that David Dunham likes David Dunham in this David Dunham balloon trip in the mathematical stratosphere of social relations.—$1.10 postpaid.—*F. D. M.*

## SHADOW ON THE LAND

*By Thomas Parran, M. D.*

SYPHILIS is the "shadow" on our land, and the nation's people have this disease on its list as the enemy in the next great battle to be fought by the aid of science. Preparation for the fight has consisted of first making the nation conscious of the need for such a fight. The first objective—breaking down the old prudishness which was preventing public discussion—fell more quickly than was hoped: it was found that the anticipated objection to the public discussion of syphilis did not materialize. Now it is being publicized and talked the Surgeon General of the United States tells what syphilis is and how it behaves, but his book is mainly a non-technical and readable discussion, not of the disease from a medical point of view but as a public health problem. It contains just the information intelligent persons would be likely to ask for about existing conditions in our nation, both among whites and negroes, what Scandinavia, England, and Europe have accomplished, the platform for action, and other pertinent matter of general significance.—$2.65 postpaid.—*A. G. I.*

## SOUND WAVES—THEIR SHAPE AND SPEED

*By Dayton C. Miller, Prof. of Physics, Case School of Applied Science*

PART I of this book contains an account of researches with an apparatus for recording sound waves, on the shapes of such waves, and a chapter on photographing bullets in flight by means of electric spark photography. Part II describes wartime research at Sandy Hook Proving Ground on pressure effects of air near large guns in action, the wave form of the sounds from large guns, and the propagation of sound waves from the muzzles of large guns; also the determination of the velocity of sound. The treatment is semi-popular. The author is a leading and noted authority on sound.—$2.90 postpaid.—*A. G. I.*

## THE CANNING PRACTICAL HANDBOOK ON ELECTRO-PLATING

PRACTICAL workers will find this volume complete in every detail of electro-plating from the preparation of the work to the finished job. It includes information on plating with the commoner metals and most of the precious metals, and gives information on lacquer finishes, enamelling, and so on.—$2.65 postpaid.—*F. D. M.*

## WORKING WITH TOOLS FOR FUN AND PROFIT

*By A. Frederick Collins*

SUPPOSE that you had never before seen a hammer, a saw, or a plane: you could read the present book and straight away go to work on making takes for granted no previous knowledge of wood-working tools and has accordingly started from scratch. His descriptions are clear, simple, and concise, and are helpfully illustrated with a large number of drawings. This is a book that will be welcomed by many a growing boy; it will be equally welcomed by the man who wants to do things around the home, yet lacks the fundamental knowledge that smooths the way.—$2.15 postpaid.—*A. P. P.*

## A STORY OUTLINE OF EVOLUTION

*By Charles W. Grimes*

A SIMPLE, direct, non-illustrated presentation of evolution, written by a Tulsa, Oklahoma, lawyer who has obviously studied his subject a great deal. Part I deals with cultural evolution—morals, writing, art, music and so on; Part II with organic evolution. The book is pervaded with theism and a teleological point of view, and is in part inspirational.—$2.15 postpaid.—*A. G. I.*

## COMPOSITION FOR PHOTOGRAPHERS

*By Richard N. Haile*

BY reducing the elements of composition to tone, line, and the "frame," it is possible to produce perfectly composed photographs with a minimum of effort and trial. The "frame," incidentally, refers to picture space limited by the borders of the photograph itself—that is, the rectangle or containing shape. Based upon the above elements, the present book gives the amateur photographer all he needs to know about good composition—if he is willing to use his eyes in translating to the photographic negative the knowledge gained by reading.—$3.65 postpaid.—*A. P. P.*

## THE MAKING AND MOULDING OF PLASTICS

*By L. M. T. Bell, Lecturer in Plastics, Borough Polytechnic, London*

WITH plastics daily finding new uses in all manner of commercial products, this is indeed a most important study for it gives the history, the present-day essentials, and the probable future developments of plastic molding. For the benefit of the more advanced chemists, the field of study in this book

formation is provided that will be of value to those with considerable experience in plastics. Much information is provided that has hitherto not been disclosed in any literature.—$5.20 postpaid.—*F. D. M.*

CULTURE METHODS FOR INVERTEBRATE ANIMALS

*By Galtsoff, Lutz, Welch, Needham, and dozens of other specialists*

A 590-page book containing the experience of scientists who are expert in rearing protozoans, hydrozoans, trematode worms, rotifers, bryozoans, spiders, insects, snails, and a host of other invertebrates for studies that require a continuous supply, as in teaching or research in genetics, parisitology, zoology, entomology, and so on; also in aviaries, aquaria, and fish culture stations. A thoroughly practical compendium, chock full of specific directions and recipes.—$4.20 postpaid.—*A. G. I.*

THE DAILY NEWSPAPER IN AMERICA

*By Alfred M. Lee*

IN the space of 797 compact text pages is carefully traced the influence of the newspaper on American life. The history of newspapers serves as a foundation upon which is built a solid structure of fact. Here the student of sociology will find much of value; the general reader will, if he can concentrate long enough, absorb a vast amount of information regarding newspapers—what they stand for, how and why they are edited, and how and why certain newspapers can and do wield such a strong influence in their own localities.—$4.95 postpaid.—*A. P. P.*

DIESEL HANDBOOK (Fourth Edition)

*By Julius Rosbloom*

TO those who know their Diesels, it is only necessary to mention that this is the fourth edition of a practical book of instruction for engineers and students on modern Diesel engineering for all types of installations. It is officially endorsed by engineering organizations.—$5.25 postpaid—*F. D. M.*

EVERYDAY FIRST AID

*By Walter Frank Cobb, M. D.*

ONE neither looks for trouble nor anticipates it. It is important, however, that everyone know the simplest first aid measures to take when an accident happens. If such a book as this is read beforehand, one can be surer of doing the right thing at the right time. After the accident has happened, there is usually too much frantic haste, too much excitement for anyone but the man with the coolest head to do the things which will help the victim before the doctor arrives. Dr. Cobb's book can be highly recommended for this reason as it covers with text and pictures the thing to be done in case of all types of accidents such as broken bones, cuts, drownings, poisonings, and electrocutions.—$1.65 postpaid.—*F. D. M.*

THE LITTLE THINGS IN LIFE

*By Barnett Sure, Ph.D., Prof. Agricultural Chemistry, University of Arkansas*

VITAMINS, hormones, and other minute essentials for health are the "little things" concerning which this well known scientist tells the story in non-technical language. Vitamins in connection with dental disorders, colds, and other ailments, infant nutrition and foodstuffs, together with discussions of minerals, anemia and goiter, foods, hay-fever and asthma, ferments and indigestion, give the scope of this book which presents a review of the work done by science up to today.—$2.65 postpaid.—*A. G. I.*

THE TRAILER FOR PLEASURE AND BUSINESS

*By W. A. Kimball and W. L. Larned*

TRAILER travelers, still increasing apace, may be divided into two general groups: those who use a trailer for vacationing, and those who use it as a perambulating office or showroom. The authors had both of these groups in mind in preparing the present book and they have done much to smooth the way for them if they will but read and profit thereby. The book is crammed with practical advice on the selection of the trailer, its equipment, operation, and upkeep. 236 pages, well illustrated.—$2.65 postpaid.—*A. P. P.*

LIFE AND DEATH

*By Andrea Majocchi*

THE autobiography, vivid and dramatic, of Italy's foremost surgeon. Despite one fault—the author's excessive self-esteem even for an autobiography—this account is difficult to put down before about 2 A.M. with the reading of its last line. It gives, in addition to a well-told, lively narrative of emergency calls to rich and poor, in palaces and reeking slums and houses of prostitution of Milan, an insight into the workings of a physician's mind, which is seldom so frankly revealed to the lay-

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NINETY-THIRD YEAR • ORSON D. MUNN, Editor


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15-11-37



WORKING up the lather preparatory to shaving is one of the vital phases of a good shave; this fact is forcefully brought out in the article "Science Turns to Shaving" starting on page 261 of this issue. Our cover photograph, by Camera Guild Inc., stresses the operation of lathering. Users of conventional blade type razors will do well to emulate.

## The SCIENTIFIC AMERICAN DIGEST




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# 50 YEARS AGO IN . . .

# SCIENTIFIC AMERICAN

*(Condensed From Issues of November, 1887)*

CANAL—"Would it not be better for the Nicaragua Canal people to buy up the partially made Panama Canal works, and finish that enterprise? It looks as if it would have to be put on sale before long, although M. De Lesseps has lately issued a bulletin saying the canal would be finished in 1890, and no more money is required for its completion. The cash they have on hand, so he gives us to understand, is sufficient."

EDISON ON LABOR—"In reply to the question 'When motive power gets to be four times as cheap as it is, Mr. Edison, what will become of the laboring man?' the great inventor replied: 'He will be enriched by it. Machinery will be his slave. See how machinery has multiplied in the last 50 years.'"

GAS LIGHT—"About two years since, we were afforded the opportunity of privately inspecting an incandescent gaslight, which was then in a more or less incomplete condition, although it gave good promise of success. This was the Welsbach incandescent gaslight, which, since that time, has been perfected in all its details and put through practical trial. Its promise of success has been realized, inasmuch as it is now the subject of manufacture on a commercial scale."

ELECTRIC WELDING—"The art of welding iron and steel by means of the heat of an ordinary fire is many centuries old, and it is perhaps one of those simple operations which would hardly be considered a subject for improvement; but the invention of electric welding by Professor Thomson not only facilitates the welding of iron, steel, and such metals as have heretofore been welded by the old time methods, but permits of the welding of cast iron, copper, brass, German silver, zinc, aluminum, and other metals which have generally been considered poor subjects for the welding process.

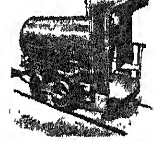
Besides these, this new process has been successfully applied to the welding of unlike metals; iron and German silver, iron and brass, being examples."

TELEPHONE—"Few inventions of modern times took the public more by surprise than did the telephone. . . . It is now employing in the United Kingdom alone more than ten millions of capital, and earning over 750,000 dollars in dividends. . . . The telephone industry has, however, made the greatest progress in the land of its birth, there being telephone exchanges in at least 860 towns in the United States. In New York alone there are exchanges with over 7,000 subscribers, besides 2,500 private telephone wires."

SPANISH NAVY—"The United States government has at last screwed up its courage to the extent of ordering ships that shall make 19 knots an hour. This is equivalent to being about a quarter of a century behind old Spain. The Spanish navy is now in possession of a war vessel, the *Reina Regente,* that sails at the rate of 21 knots per hour. (*Sic.*) Probably by the time our 19 knot ships are ready, Spain and other nations will have vessels that can make 25 knots."

TUNNEL—"At a recent meeting of the geological section of the British Association, a report was read on the present condition of the experimental heading for the channel tunnel between Dover and Calais, a distance of 21 miles, the completion of the work having been forbidden by the English government. A hole has already been bored 7 feet in diameter, one mile and a quarter in length, nearly the whole of which is actually beneath the sea bottom. Most of the work was done five years ago, and as it has gone through a chalky formation needing no lining, it has remained perfectly dry and the substance at the surface of the boring has become harder by exposure to the air."

COMPRESSED-AIR LOCOMOTIVE—"Among the various systems of underground haulage shown at the Newcastle exhibition is one employing compressed air, and which deserves special mention. . . . We illustrate, in the annexed engraving, the locomotive exhibited at Newcastle. It is a four-wheeled engine, with inside cylinders, and the portion which in an ordinary steam locomotive would be the boiler is replaced by a cylindrical reservoir containing air under pressure. This locomotive has been shown in action since the opening of the exhibition, and drawing generally four tubs, but sometimes six, each weighing 25 cwt. The total weight of the engine is about 2 tons. The cylinders are 4 in. diameter by 7 in. stroke, and the engine runs on a 33½ in. gauge."



NON-MAGNETIC WATCH—"In these days, when dynamos and electric motors are everywhere met with . . . the production of a watch that is utterly unaffected by the strongest magnets is an improvement well worthy of special notice. . . . A cure for the whole affair is found in the invention of Mr. C. A. Paillard, of Geneva, Switzerland. He has applied palladium to the manufacture of watches, using it for those parts which are usually constructed of steel."

SPEED—"The fast locomotives used on the 'two-hour' trains of the Pennsylvania Railroad Company, between New York and Philadelphia, have 6 ft. 8 in. wheels, 18 in. cylinders, and 24 in. stroke. The engines do a mile in 50 seconds."

BRITISH RIFLE—"According to Sir Henry Halford, the new army rifle is to have a very small bore, about 0.3 inch, and will be a repeating rifle, with a magazine holding 10 shots. Owing to the reduction of bore, each soldier will be able to carry 166 rounds into action as easily as 100 rounds of the present ammunition. The trajectory of the arm will be very flat, so that, it is expected, as good shooting will be made at 1,000 yards with the new rifle as was made at 600 yards with the Martini-Henry, and at the same time the recoil will be reduced to one-third that of the present arm."

SECONDARY BATTERY—"A new type of secondary battery was employed on an electric launch recently tested by the French naval authorities at Havre. . . . The number of cells used was 132, which furnished a current of from 87 to 89 amperes under a difference of potential of 100 to 104 volts, and the weight per horse power per hour was about 73 pounds."



AND NOW FOR THE FUTURE

**What the past ten years of experience have taught the aviation industry.**

**Heavy nitrogen, by Barclay Moon Newman.**

**Greater New York's latest vehicular tunnel system, by R. G. Skerrett.**

**The second installment of the intriguing story of Ra-mose and Hatnufer.**

**There is value in old automobile tires, by Philip H. Smith.**

# *Personalities in Industry*

DR. FRANK CONRAD

A SMALL, modest, elderly man, little known outside engineering circles, attended the last Milwaukee meeting of the American Institute of Electrical Engineers to receive the Lamme Medal, one of the Institute's highest awards, for "pioneering and basic developments in the field of electric metering and protective systems." This man was Dr. Frank Conrad, Assistant Chief Engineer of the Westinghouse Electric and Manufacturing Company, and behind him stretched a lifetime of important inventions, many of which are still in operation around us; some of them have helped to change the world.

The Lamme award was made, in part. to celebrate Dr. Conrad's invention of the small, round type, watt-hour meter. This occurred 30 years ago, and since then more than 30,000,000 meters of this type have been manufactured.

In all, about 300 patents have been issued to Dr. Conrad, nearly all for electrical improvements and developments, but none of these covers his greatest exploit. On November 2, 1920, at Station KDKA in Pittsburgh, he launched radio broadcasting on the world after months of experiment in his private radio station in a garage at Wilkinsburg, Pennsylvania.

Dr. Conrad's connection with broadcasting is not as widely known as some of his other achievements. Back before the World War, he made a five-dollar bet with another Westinghouse engineer over the accuracy of his watch. To settle the wager, he put together a small radio set to receive the Arlington time signals. He won the bet, but by that time it didn't matter. Radio had claimed him. When the United States entered the World War, Dr. Conrad was so widely recognized as an expert that the government called him to develop radio equipment for use in airplanes and in the front-line trenches. After the War, he went back to his experiments.

Early in 1920 Dr. Conrad began radio broadcasts from his garage-station, putting phonograph records, amateur performers, and speakers on the air regularly twice a week. Presently, one of Pittsburgh's large department stores, the Joseph Horne Company, advertised radio sets that could be used "to hear Dr. Conrad's broadcasts." With this evidence of widespread interest, the engineer was able to enlist the co-operation of Westinghouse officials and an inter-company radio station applied for a license to do commercial broadcasting. The application was granted and the new station became KDKA.

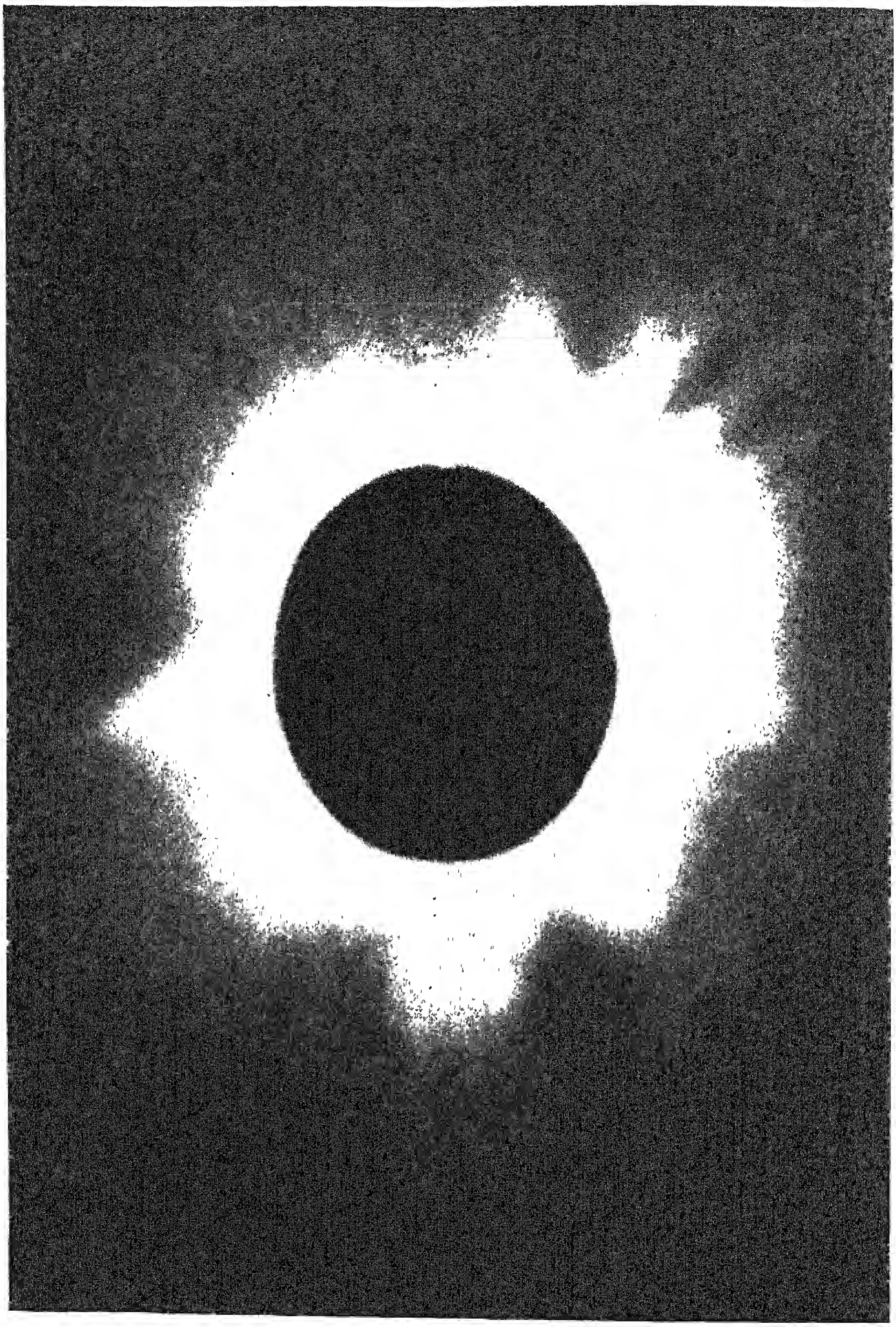
But Dr. Conrad, whose engineering, skill and imagination had started the whole business, was not present at the first broadcast. So fearful were the engineers that the makeshift apparatus at KDKA would fail, that they stationed Dr. Conrad in his garage, on a branch telephone line, to carry on the broadcast if the regular station should cease to operate.

Dr. Conrad subsequently developed short-wave apparatus and helped establish the first radio relay station at Hastings, Nebraska. He was one of the first experimenters to demonstrate that short-wave radio could be transmitted across the Atlantic..

This lifetime of achievement was accomplished without the aid of a formal education. When Dr. Conrad joined the Westinghouse company in his teens, he had not even completed grammar school, and his first job was in the machine shops. His ingenuity soon attracted such attention that he was transferred to the research laboratories.

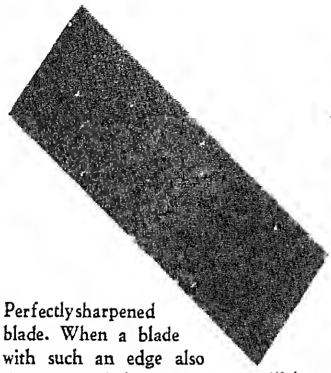
His present assignment, as Assistant Chief Engineer, is a roving one. He works on whatever problem interests him most. Other engineers bring him their worst puzzles for solution. Around the Westinghouse engineering laboratories he has a reputation for uncanny insight into the ways of materials and electricity. At one time he designed, by rule of thumb, a new type of transformer. Another engineer, to make sure the design was correct, labored for weeks with mathematics. His results were a complete confirmation of Dr. Conrad's design, worked out in about 30 minutes.

To people who call him a "scientist," Dr. Conrad is apt to reply that he prefers to be known as an engineer. With proper pride, he explains that scientists may discover important natural principles, but an engineer is a man who makes things work.

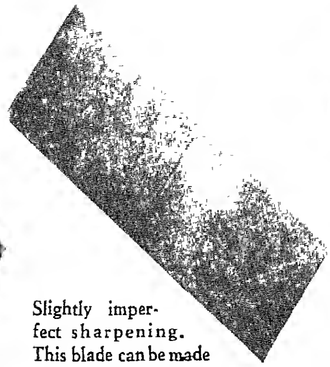


## ASTRONOMY FROM ABOVE THE EARTH'S ATMOSPHERE

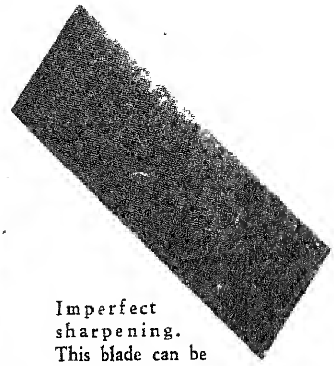
ASTRONOMERS often assert that what we human beings can see beyond the earth is only what the annoying earth's atmosphere permits us to see, and it is certain that we could see much more if we could go beyond it or successfully command it to draw away from in front of our instruments. However, by going in an airplane to an altitude of 25,000 feet (above most of the atmosphere) and photographing the sun's corona during an eclipse, Major Albert W. Stevens, a member of the Hayden Planetarium-Grace Eclipse Expedition, has revealed for the first time that the solar corona is not merely the familiar array of finger-like streamers from the sun but a globular layer a million miles thick surrounding it. The photograph shows the spaces between the "fingers" lightly filled in to a uniform distance.



Perfectly sharpened blade. When a blade with such an edge also shows a good sharpness test, it will have the best possible durability in actual use



Slightly imperfect sharpening. This blade can be made to show a good sharpness test, but will not be as durable as the perfect edge at left



Imperfect sharpening. This blade can be stropped to show a fair sharpness test despite ragged edge; its durability is poor

# SCIENCE TURNS TO SHAVING

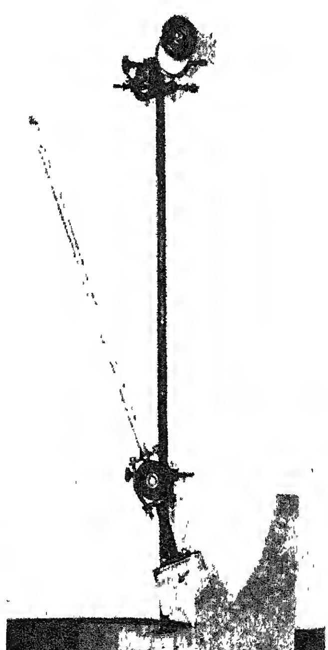
**New Shaving Facts . . . Razor and Blade Design Important . . . So Is Blade Angle . . . Teeth in Blade Unnecessary . . . Razor Steels . . . Lather Two Minutes or More . . . Shaving Technic Often Poor**

By ELBRIDGE J. CASSELMAN*

BEFORE the days of the pencil sharpener, the writer used a pocket knife to keep points on his school pencils. His best efforts with a hand stone failed to sharpen the knife sufficiently to shave hair. Therefore, it was a striking discovery to find that the freshly sharpened knife would shave after it had been stropped on the leather upper of his shoe. Since that time he has learned still more about sharpening cutting edges and has found that razors which have had a leather stropping as a final step are the sharpest edge tools.

POGONOTOMY (derived from two Greek words meaning "to cut the beard"), or shaving, was one of the early arts of history, rivalling the other arts of personal adornment in antiquity. The excavations of archeologists have uncovered in many places objects that they believed to be razors. The earliest razors were made of bronze and some examples are in the British Museum. The Roman razors were of iron, as were the razors recovered from the ruins of Pompeii. The writer has demonstrated the possibility of sharpening bronze, pure iron, and even copper to the point where shaving is possible, which strengthens the claims of historians. The ancients must have been stoical he-men, as experience with these materials shows they would never shave comfortably.

With the introduction of steel that could be hardened by heat treatment (Damascus steel, for example) it was possible in ancient Greece to produce razors of quality about equal to those of today. Natural stones were available for grinding an edge and for honing it; textile materials and tanned leather had been in existence for centuries, so that an edge sharp enough for shaving could have been produced by methods much like those in present use. No doubt shaving was occasionally accomplished with first rate equipment, but lack of knowledge of what constituted good equipment must have doomed many attempts to make good razors.



Early model of a sharpness tester. Blade held in top of swinging arm

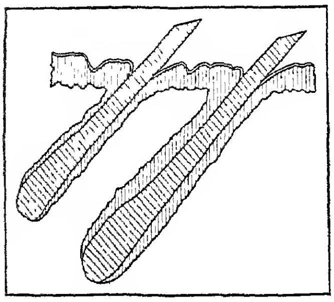
In the important matter of preparation for shaving, we have little evidence of the ancient practices. Detergents were known and used, especially in religious rites, but the types of soap that we use today, especially those containing a minimum of alkali, were probably little known or utilized. Shaving must have been torturing, and it is natural that a special group of artisans, the barbers, should have been formed, whose business was shaving and tonsorial adornment. Rome's first barber came from Sicily about 300 B.C., but there were barbers in Greece before 400 B.C.

The difficulties and discomforts of shaving probably had some influence on tonsorial styles, but there were other influences as well. The Bible contains decrees regarding shaving and the use of razors. Alexander the Great reversed the Macedonian fashion of wearing a full beard lest an enemy be given a "handle"

*For the past five years the writer has engaged in a comprehensive study of shaving technics and devices. Facilities for the investigation were provided by a Fellowship at Mellon Institute of Industrial Research in Pittsburgh, maintained by the Magazine Repeating Razor Company. In these studies all phases of shaving were examined, from the physiology of the growth of hair to the metallurgy and sharpening of safety razor blades.

to seize in slashing at soldiers' throats. Among the Romans the younger Scipio deserves a place in the history of personal hygiene as the first Roman to shave every day. The Roman emperors did not all follow his example; from Hadrian to Constantine they were full-bearded.

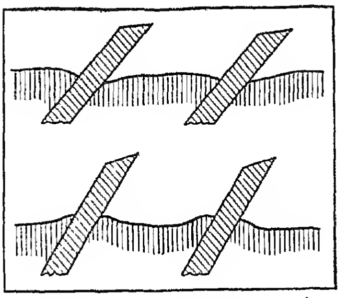
There have been controversies, frequently acrimonious, regarding shaving the beard, based on everything from



An enlarged section through the hair and skin of beard; glands, muscles, nerves, and so on, not shown. The drawing indicates the average thickness of the corneum and epidermis, coarse wrinkles, and the pit surrounding the hair shaft

piety to sanitation. Even today the discussion occasionally appears in British newspapers and periodicals. Medical men have taken sides at times, the defenders of the beard pointing out its value as a heat insulator and air strainer for the pathogenic organisms; the opponents have held the beard to be unsanitary because it is a micro-organism trap. Most physicians in America are clean-shaven and few favor the unshaven face. Neither physicians nor their collaborators in allied fields have ever demonstrated that daily shaving affects the hair. Their evidence indicates there is no effect whatsoever on the growth rate, coarseness, or density of spacing, after the change from the downy hair of adolescents to the stubborn beards of manhood.

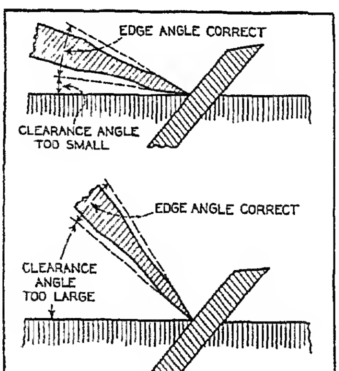
THE art of shaving as practiced by barbers has probably changed little with age, except as they have taken advantage of the few advances made from time to time. One of these advances was the introduction of "hollow grinding" in the 18th Century, which facilitates the honing process in the sharpening of a razor. Another was the development of soaps less harmful to the skin than the soda and potash chemicals available to older civilization as detergents. The present practice, in which most men shave themselves, did not take place until the invention of the replaceable safety razor blade. This forward step made it possible to transfer from persons to machines the great skill necessary to sharpen a razor and to replace this dexterity with the relatively simple motions of reloading a safety razor.



*Top:* Sectional drawing of hair and epidermis after mild stretching of the skin. *Lower:* The same section after over-stretching skin, especially over the bony parts of the face

The replaceable safety razor blade was invented at the beginning of the 20th Century. A guard bar for preventing the cuts that occur when unskilled hands use a knife-type razor had already been fitted to such razors as early as 1875 by Michael Hunter, of Sheffield, England. Rolling mills producing steel six to twelve thousandths of an inch thick were unknown. The cheap replaceable blade, manufactured from such steel, had to wait for the coming of these mills. Tool steel of these dimensions can now be rolled by any "wire mill" and any one of several manufacturers can produce sharp blades from it. Today such blades are used by about 90 percent of American men.

The effects of the widespread use of safety razors have been social, economic, and dermatological. Among the social effects may be mentioned the passing, probably for good, of the full beard as a style. Faces that are smooth shaven every day have been with us in large numbers for over a quarter-century, and have demonstrated that their contribu-

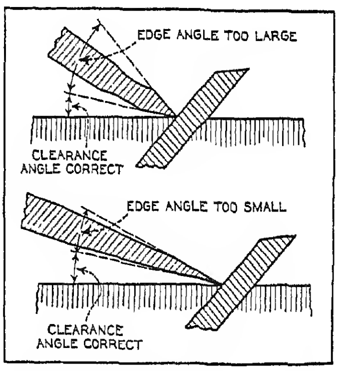



*Top:* The shaving condition which pertains when the edge angle is correct but the clearance angle is too small. This results in a long, pointed stubble, minimum damage to the skin, and minimum discomfort due to "pulling." *Lower:* Shaving condition when the edge angle is correct but the clearance angle is too large. Results in this case are a close shave with little effort, maximum damage to skin, and great discomfort due to "pulling," unless the razor blade used is very sharp

tion to personal hygiene outweighs the debatable value of the beard as a protection for the skin. Socially, this is probably quite important for it is believed that the psychological effect of the daily shave is to improve the temperament and the temper of the nation. The dermatological effects have been, in general, the promotion of skin health.

Of shaving in general and razor blades in particular, science has learned many things in recent years. In the following discussion, new facts will be told and old traditions smashed—all in the interest of better shaving. The technical opinions expressed have been arrived at as a result of extensive laboratory investigation.

One of the first studies made—a fundamental measurement—was of the change in sharpness of razor blades as a result of shaving. The device used for this purpose (U. S. Patent #1,983,597) depends directly upon the capacity of the edge to cut very fine rayon fiber at a point ½ inch below a grip from which the fiber is freely suspended. Instead of measuring the force necessary, it was found more suitable to measure the velocity of the blade, when freely swinging on a pivoted arm, necessary to cut




*Top:* Shaving condition when clearance is correct but edge angle is too great. The principal effect is increased "pulling" during shaving. *Lower:* Shaving condition when clearance angle is correct but edge angle is too small. The results are: A close shave with little effort, considerable damage to skin, and minimum discomfort due to "pulling"

the fiber. The results are expressed arbitrarily in velocity units—feet per second—which are a direct quantitative measure of the shaving quality of the blade. An early model of the device is shown in one of the accompanying illustrations. The scale of the testing device was graduated to cover the whole useful range of razor blades, from the scale reading of ½ unit, which represents the sharpest blades ever tested, through the range of 6 to 9 units in which many men discard used blades, and to the range of 10 to 16 units in which blades are useless for shaving. By means of this test, it is possible to study the effects of

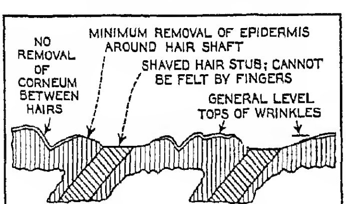
sharpening practice on both sharpness and durability; the effects of steel composition and quality upon the capacity of a blade to take a sharp edge and to retain it when in service; and the effects of shaving practice and of blade storage upon the failure of the blade edge. It was found to be a very useful means of control and interpretation in all kinds of shaving tests. The microscope was also a useful accessory in these studies; it was particularly valuable for the examination of blade edge profiles.

Data of great importance were obtained from the reports of experimental shavers, of whom some 10 to 15 shaved themselves according to directions every day for several years. They were provided with experimentally prepared razors, blades, and soaps. They observed, as a routine matter, the effort required for a close shave, any "pulling" sensation or other discomfort during the process, and any evidence of skin injury.

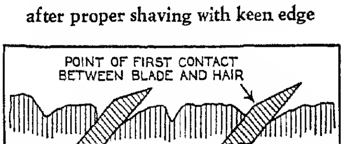
LABORATORY methods were also devised for measuring the quantities of skin and hair removed by each daily shave. These methods involved collecting the debris from the razor and centrifuging it in suspension in a soap solvent.

The time required to soften hair by soap and water solutions was made a separate study by measuring the stretch of submerged single hairs under a load of 16 kilograms per square millimeter during definite time intervals. By this method, the tremendous effects of water temperature on the rate of hair softening were demonstrated in the laboratory.

All important conclusions reached in the tests were checked by the so-called "comparison shave," a method which the average shaver can apply. The technic calls for the use of two single-edge razors that are alike in every respect except for the condition that is to be studied. The beard is completely softened as described subsequently (unless, of course, lathering procedures are being studied), and one razor is used on each side of the face. On subsequent days the order of shaving the face is reversed so as to eliminate differences arising from any uncontrolled variables. Pains are taken to compare carefully the amount of effort required to get a close shave, the amount of pulling or other discomfort such as scraping sensations, and the amount of skin damage.

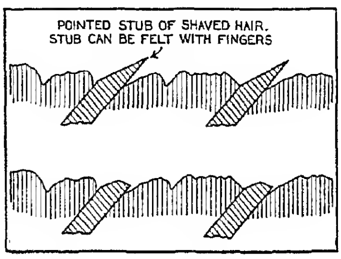



**The condition of the skin and hair after proper shaving with keen edge**

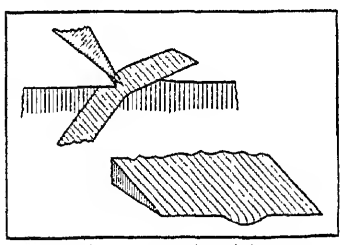



**Condition of hair stubble when shaved without stretching the skin. The stubble can be felt with the fingers, especially against the grain**

Failure to control essential variables by some such test is probably responsible for many of the false notions regarding shaving; for example, the relative importance of actual shaving and corrosion of the edge during storage as contributing factors in the failure of the cutting edge. The edge becomes dull during shaving, not during storage, unless it is left actually wet for some hours.



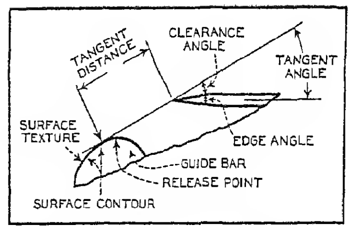

***Top:* The pointed stubble of the shaved hair results from the use of a dull blade, too small a clearance angle or too great an edge angle. *Lower:* Condition of the hair stubble when shaved first with the grain, then against—medium sharp blade**



***Top:* The extreme edge of the razor blade is slightly deflected during the actual cutting of the hair, as shown in the lower drawing. This is exaggerated by a small edge angle and also by a large clearance angle**

Some of the well-confirmed results of this five-year study can be stated. The most probable cause of unsatisfactory shaving with a new factory-sharpened blade is incomplete preparation of the beard. (Correct preparation will therefore be dealt with in detail later in this article.) The tendency to ascribe all shaving troubles to the blade is so widespread that razor-blade technology will be considered here.

Safety razor blades are made by automatic machinery that does on a large scale what barbers do by hand. The blade is hollow ground to give the edge its general shape and dimensions. It is then honed with the finest honing materials, increasing slightly the angle that was produced at the edge by the grinding. Then it is stropped, using a considerably greater footage of stropping than does the average barber. Furthermore, the stropping pressure and angles are controlled to a much more accurate degree than can be done by hand stropping or by any of the resharpening devices. When the pressure adjustments are correct for the grade of steel being sharpened, the result is a "perfect" edge. We can define such an edge as one having a sharpness under 1.5 units on the scale described above; one having no visible teeth or serrations in the profile of the edge; and one having the bisector of the edge angle parallel to the central plane of the blade. Both the radius of curvature of the edge, and the teeth (if invisible ones are present), are much smaller than the average spheroidized carbide particle that is a characteristic constituent of razor grade steel. The makers of the best razor blades attain this condition in a large proportion of their product. When a blade is in this condition, it will give the best possible satisfaction and maximum durability in shaving.




**There is more to the design of a safety razor than merely making a new type of guard and blade. The drawing shows some of the important features which must be taken into consideration if shaving with the razor is to be satisfactory. The features shown pertain to a solid guard type of razor. If the guard consists of teeth, two to three degrees are added to tangent angle**

THE quality of the steel has an indirect effect only on the durability because, within a surprisingly wide range of steel quality, all perfect edges have almost equal durability. The quality of the steel has an important effect, however, on the ease with which a perfect edge may be produced. To that extent it affects the lasting qualities indirectly. It is of economic importance to the blade maker to use the steel that sharpens the most easily, hence it follows that razor blades are made from the best steel for the purpose.

The most frequent departure from perfection of the edge is in the presence of small teeth or serrations. They are hard to eliminate; the correct adjustment of factory stroppers to do so is something of an art. They are the most important single item that affects the durability of the edge. Freedom from

serrations is the prime essential of good durability, compared with which other factors including steel quality are of minor importance. As a condition, it was so frequently missed by barbers and by the early makers of replaceable blades that a traditional belief in the necessity for fine teeth in the edge of a razor has grown up. Because of the failure of hand stropping to attain this toothless condition, the skilfully manipulated "slanting" stroke for shaving has been developed by many users of barber's razors. Such stroking methods are unnecessary with the best safety razor designs, although their use is always beneficial. A diagonally directed stroke definitely prolongs the effective life of the blade edge when it begins to get dull.

When a razor user thinks he has found a blade made from soft steel (a frequent complaint), the chances are that, instead, he has a blade with a rough edge. It is possible but not economical to put "perfect" edges on steel that is considerably softer than razor grade steel. And it is extremely difficult to put perfect edges on harder steels than those of razor grade. To do so would result in a practically inconspicuous gain for the user. Steel for a perfect edge, produced economically, must be neither too soft nor too hard.

The satisfaction that a blade will give can be predicted by simple non-destructive tests for sharpness and freedom from roughness. These tests are also useful in evaluating the effectiveness of blade resharpening devices. Most of the resharpeners that are available at present will improve a blade from the condition where it is no longer useful (say a sharpness of 9 units) and make it again serviceable for one complete shave without further resharpening. No resharpener will prepare blades that are the equal of the factory sharpened blades for which safety razors should be designed. If one finds that a resharpened blade gives him a close shave, it is strong evidence that the razor in which he uses it is improperly designed. A bloody face often results from the use of a new factory-sharpened blade in such a razor.

The actual shaving operation itself removes from 0.006 to 0.030 cubic inch of dampened skin along with the daily growth of hair. This skin is not removed in a uniformly deep layer over the shaved area, but principally from around the individual hair shafts. The effect is not important normally, since the outside layer of skin is constantly wearing off and replacing itself by natural growth. When it is aggravated, bloody spots sometimes appear, leaving the skin open to infecting agents, and providing a mechanical basis for ingrowing hairs. This aggravation may result from any practice that contributes to a "close" shave. Among such procedures are the use of a new sharp blade in a razor that is designed to be used with dull blades; shaving over the face

*Hair chips—cross-cut, splintered, and sliced—as removed in normal shaving. Magnification is about 40 diameters*

more than once, especially against the grain; and pressing hard on the skin with the razor. The design of razor that minimizes the skin removal is also the one that lessens the pulling and scraping effects of shaving.

Some of the important features of safety razor design are shown in the accompanying drawings. It is to be noted that the shaving angle between the blade and face is controlled principally by an element of the razor design which is called the "tangent angle" in one of the illustrations, rather than by the user's method of holding the razor. The other drawings bring out the complex situation of conflicting items in the choice of the tangent angle. The selection of a large tangent angle to secure a close shave results in excessive removal of the surface skin and in the probability of pulling discomfort.

DESIGN for a safe, comfortable shave results in the possibility of failure to get a close shave. The safest shave is obtained when the tangent angle built into the razor is less than 25 degrees. Even when a new sharp blade is used with such a razor, it must be passed over the face more than once in all directions for a close shave, and the third or fourth shave with the most durable type of blade may seem to be unsatisfactory. For this reason, very few commercial safety razors are constructed to have such small tangent angles. The tendency of many razor makers has been rather to conform in their designs to the needs of those who want a close shave in a hurry. That is, they have adopted a large shaving angle. Some commercial safety razors have been found with tangent angles measuring as high as 56 degrees. Such razors give the user a feeling of scraping during use, and, therefore, sacrifice both freedom from skin irritation and comfort to give the user a close shave with dull blades. Of course, an angle exists that gives a good compromise between these conflicting effects. It is not the same for all users because of the wide variation in individual tastes and needs; however, a tangent angle of 28 to 32 degrees appears to be the most suitable for many men.

Even in the case of correctly designed razors, some variation in effect will be observed occasionally. In razors where the blade edge is definitely placed with relation to the guard by a stop or lug, this variation may be due to an unsymmetrically honed or stropped edge; that is, one where the bisector of the ultimate edge angle is not in the same plane as that of other blades of the same make. Obviously, the shaving angle will be affected thereby. In the usual double-edge razor having no stops, both this unsymmetrical condition and varying blade width dimensions may be the cause.

Speaking in terms of the shaving practice of the average man, the most probable cause of dissatisfaction is his faulty facial preparation. Water is actually the great softening agent for hair. No other material is comparable with it, except those having a specific chemical action, and these are sometimes dangerous as their action extends to the skin as well. Water penetrates the hair by absorption, reducing its strength and hardness some 60 percent and its elastic properties about 90 percent. The softening effect is quite important when we remember that dry hair is harder than lead, aluminum, or annealed copper, being comparable with dry paper in its capacity to ruin cutting edges. The ultimate effect of water is little influenced by its own hardness or softness. The degree of alkalinity introduced by soap may make the final hair condition somewhat softer than does neutral water. The rate at which the soft condition is approached, however, is affected by some important factors, of which water temperature appears to be the most pronounced.

Lathering the hair with hot instead of cold water is sure to bring about the approach to complete softening sooner. However, a detergent is necessary for the removal from the hair of

(Please turn to page 314)

# OUR POINT OF VIEW

### Who Foots the Bill?

SINCE the railroads have long been a political football, it is not so hard to understand part of the motive behind the effort to limit the length of freight trains to 70 cars by law. The Senate recently passed and the House has pending a bill to make this limitation. The stated theory behind it is that the limitation will improve railroad safety.

We are not interested in the politics of the question but, as a shipper and a consumer of shipped goods, we are definitely concerned. Farmers, shippers, and industry in general are concerned, for they—and we—would have to shoulder a vastly increased railroad burden; the alternative is bankruptcy for the railroads and inefficient, wasteful, costly government operation.

The railroads are not wealthy. In the past, many of them have been bankrupt and even now 28 percent of the railroad mileage of the country is in the hands of receivers or trustees in bankruptcy. Despite this fact, railroads have spent over eight billion dollars since 1923 in additions and betterments to their properties —eight billions which benefited the entire country.

The new bill, if it becomes law, would make necessary the operation of 147,000,000 additional train-miles to handle the traffic of a normal year (based on 1930), would involve out-of-pocket operating expenses (also 1930) of not less than 125,000,000 dollars, and would force tremendous capital expenditures for track and yard facilities and for engines suitable for shorter trains. Add this 125,000,000 dollars to the loss due to reduced freight revenues because of reduction of average revenue per ton per mile; and increases in expenses due to the advance in prices, to previous advances in wages, and to demands for other wage advances—adding all these, we have a total of 639,000,000 dollars. This would wipe out 95 percent of the net operating income earned in 1936. The public would pay this or government operation would inevitably follow.

Perhaps the improvement in safety is worth this increased cost? No. Statutory three-judge courts sitting as District Courts of the United States in both Nevada and Arizona have decided otherwise in cases involving state train-length limitation laws. The actual record is equally as emphatic. From 1923 to 1935, the number of cars in the average freight train increased 16 percent while accidents to trainmen were reduced 61 percent and to passengers 71 percent. Additional train-miles would correspondingly increase the opportunity for such casualties. Obviously, grade-crossing accidents would also increase in proportion to the greater number of trains passing any given crossing.

The theory thus failing to hold water, there remains only the actuality. The new law, if passed, will necessitate increasing the number of trains—ergo, the number of train crews composed of more men to raise the membership of the engine and train service brotherhoods sponsoring it. For such a reason must we, the public, foot such an enormous bill or risk disastrous government operation of the railroads? If the brotherhoods are myopic, isn't it about time that we, the public, take a hand?

### To Amplify Wealth

ONCE more in scientific circles there is much discussion, some of it heated, concerning a practical question which probably will not down until it is definitely settled one way or the other. The question is whether scientists should continue making discoveries and giving them freely to the world—which means in actual practice giving them to astute business men who use them in profit making—or whether the scientists should patent their discoveries and, through suitable agents of their own choosing, in effect put science itself into business. The proposal is that science should use the profits for the further maintenance of laboratory research which in turn will make possible still other discoveries. In neither case would any scientist personally acquire any wealth.

The idea is a kind of "regenerative feedback." It is now being considered because the sources of large funds are likely more and more to dry up as our nation passes out of the period in which freshly opened resources will permit the acquisition of huge fortunes to be shared by science.

In large measure, while the world is slowly coming to sense the roundabout connection between money granted for scientific research and the returns from that research, it still fails to sense that connection very clearly, and therefore it fails to reinvest a large enough part of its earnings in scientific research. Therefore, until that realization has fully arrived, why should scientists not retain control of their discoveries and feed the proceeds back into the circuit, thus bringing about greater amplification of the research funds? To some extent this is already being done.

Times change and, with them, conditions change. Despite some minor drawbacks freely admitted, which might affect the system, we strongly favor this regenerative feedback for the funds of scientific discovery.

### Radicals

FACE washing is reported by one psychologist as having a definite bearing on the character of young political radicals. No: not simply too much face washing but too much face washing against the will of dirty faced youngsters. Their revolt, as children, against this hygienic rite is said to exemplify their rebellious spirits and to lead them, in combination with the attendant nagging, reproach, and ridicule, toward an "agin everything" attitude.

If the good doctor means that radical youth didn't relish face washing as children, we agree that this is almost self-obvious. Radicals are malcontents. Quite likely they would be constitutionally opposed to anything so illuminating, if we might so express it, as to show the clean skin beneath. In a highly competitive economy wherein it is given to each according to his ability and enterprise and where the knocks are hard, they "can't take it." They are the Something-for-Nothing boys of the order of jackals; lacking the will to work out their own destinies or the ability to outline an orderly plan for human progress, they demand hand-outs and would attach the fruits of other men's labors (by force, if necessary) and destroy the competition against which they can not stand up. Knowing their inability to adjust themselves to our system of struggling for existence, they mask their inferiority complexes with a pose of intellectualism, so called. And still they refuse to wash their faces!

As we read the report, however, we got the impression that the psychologist meant that forcing the child to wash his face influences him to become radical. If so, the report must have erred; the doctor could not have meant that. Resistance to face washing is too general among children. Indeed, the large majority of children don't like it, have to be driven to it. But most of these youthful revolters are not revolutionists. Of superior intellect, they are the red-blooded, hard-hitting fighters of future competitive businesses and governments. They are the little rascals, freckle-faced and grimy, whose faces, in later years, will be marred by the dust and sweat of the arena of progress.

# Ra-mose and Hat-nufer

EDITOR'S NOTE: Human interest rather than special archeological or historical significance is the mainspring of the intriguing account which follows. Its reader will be at the side of the archeologists of the Metropolitan Museum of Art Egyptian Expedition as they withdraw object ofter object from the well-packed tomb, not of dazzling royalty but of two plain, middle-class people—commoners—whose only claim to note lies in the pertinent fact that their son, by hook or crook, and no doubt by the plentiful exercise of gall, had risen from his humble station to the rank of personal dictatorship behind the throne of Egypt occupied by a regent queen—herself in part a usurper.

With occasional smiles at some of the rather amusing facts revealed, we shall learn just how this dictator buried his father and mother—the one with meager attention, the other with considerable display for a commoner—and how he planned to have himself finally buried in royal splendor before fate caught up with him and probably "bumped him off." No doubt Ra-mose—for that was the dictator's father's name—would have been considerably annoyed had he known that several hundred thousand inquisitive American readers 3400 years after his decease would be amused to learn that he had but one shirt—"grafted," at that, from the royal linen stores.

In order to understand the account, which is from the *Bulletin* of the Metropolitan Museum of Art, it is helpful to know the background. About 1000 years after the pyramid age in Egypt, when the capital had been moved 250 miles up the Nile to Thebes, and about a century before the time of Tutenkhamon, a king named Thutmose II ruled, and in the year 1501 B. C. he died. His little son was too young to rule, so the regency was entrusted to the widow, Queen Hat-shepsut—not to be confused with the humbler Hat-nufer previously named. The queen was young, and herself admits in inscriptions that "to look upon her was more beautiful than anything; her splendor and her form were divine; she was a maiden, beautiful and blooming." A frank woman!

Among the contemporaries of this beautiful and blooming queen was an able, energetic, handsome (we have several of his portraits) and ambitious man named Sen-Mut. After the king's passing, this opportunist lost no time in feathering his own nest with the person in power, just as similar things are sometimes done today, 3438 years later. Forthwith, Queen Hat-shepsut appointed him to an office that gave him charge of the Temple of Karnak and of the Royal Palace. Soon he had absorbed other offices, and in time he was the queen's right hand man in various senses—he became Overseer of Overseers of all the Works, Superintendent of the Royal Slaves, of the Treasury and of the Armory; and, in addition, he became Superintendent of the Private Apartments, and then of the Bathroom and finally of the Royal Bedrooms. In short, Sen-Mut, by the simple process of reaching for more, became Chief of the Works.

As no woman could be full ruler of Egypt, Queen Hat-shepsut did something quite original—she had herself declared King! Today one may see in the Metropolitan Museum of Art, in New York, large granite statues—true originals brought from Egypt—of this queen which depict her as a man king. There are evidences that this new usurpation rôle of the queen's was the idea of Sen-Mut the resourceful, and was promulgated by him.

With everything going his own way Sen-Mut next thought of his own burial and built an expensive tomb in plain sight on a hill, and this tomb was discovered a century or so ago. Then the old fox secretly built another tomb for his actual burial, only recently discovered. For it, he tunneled under the sacred precincts of Hat-shepsut's royal temple, and he had it made like the queen's. On the ostensible tomb he left the following modest inscription: "I was the greatest of the great in the whole land. I was the guardian of the secrets of the king in all his places; a privy councillor on the Sovereign's right hand, secure in favor and given audience alone; a lover of truth who showed no partiality; one to whom judges listened and whose very silence was eloquent. I was one upon whose utterances his Lord relied, with whose advice the Mistress of the Two Lands was satisfied, and the heart of the Divine Consort was completely filled. I was one whose steps were known in the palace, a real confidant of the Ruler, entering in love and coming forth in favor, making glad the heart of the Sovereign every day. There was nothing from the beginning of time which I did not know." Sen-Mut also is frank!

However, after 18 years of this kind of rule the stripling son of the deceased king (by another wife than Hat-shepsut) had grown older. Just what happened is unrecorded but these are the evidences: In Sen-Mut's secret tomb all his own portraits are found to be mutilated—the faces are smashed, though Hat-shepsut's name is still granted due respect. Something apparently "happened" to Sen-Mut! He disappears totally from history—both of his tombs were found quite empty. Three years later Hat-shepsut herself died. The new king, Thutmose III, was at last sole ruler of Egypt. One of his first moves was to have all the statues of Hat-shepsut hauled to the dump and broken in pieces, with every conceivable indignity heaped upon her likeness. Some of those same statues, carefully put together again, are to be seen in the Metropolitan Museum of Art.

At some time during the reign of Hat-shepsut and her stooge Sen-Mut—if the circumstances were not reversed—the parents of Sen-Mut died, and the account which follows concerns wholly the excavation of their tomb. A large part of the simple objects described and shown in the illustrations are to be seen in the originals at the Metropolitan Museum of Art in New York. One's feeling on viewing them is, how remarkably well they were built, how remarkably preserved after 34 centuries—fully as fresh as the things only a century old that we find in our own attics. Even the food found in the tomb looks edible—the raisins and dates as if they could be soaked and eaten today, the cakes brittle with age but sound, and on viewing all these objects the distant story is as if it had happened but yesterday.

*(In Three Parts—Part One)*

By AMBROSE LANSING

Associate Curator of the Department of Egyptian Art of the Metropolitan Museum of Art; In Charge, Metropolitan Museum Excavations in Egypt

and WILLIAM C. HAYES

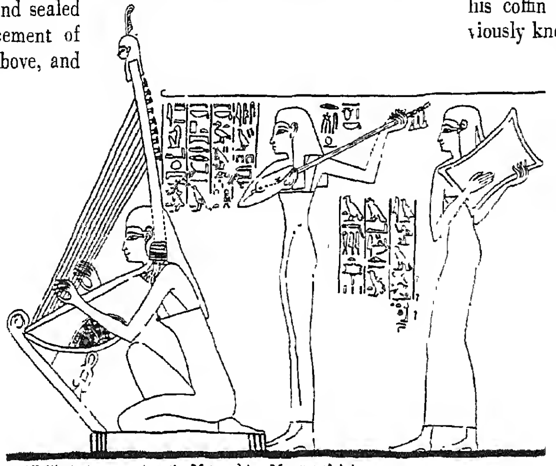
Assistant Curator of the Department of Egyptian Art of the Metropolitan Museum of Art

JANUARY 11 proved to be a memorable day. In the early morning word came down from the dig that the section of the gang clearing the upper slope of the hill had uncovered another deposit of objects close against the rock face, a short distance below the forecourt of the tomb of Sen-Mut. The deposit consisted of a rectangular tambourine, into which had been thrust, through a gaping hole in the rawhide cover, the parts of an elaborately carved chair of boxwood and a darker wood, and the upper part of a cedar headrest of good quality. The tambourine (Figure 1), a rectangular wooden frame with incurved sides and ends, completely covered by a single large piece of tightly stretched rawhide, is the only example hitherto found of its type, which is, however, like the lute, well known from New Kingdom paintings (Figure 2). The chair, shown reconstructed in Figure 3, has a well-preserved seat of cord mesh. Its legs are carved with care to represent those of a lion, and its paneled back displays at the top an openwork design, composed of a figure of the household god Bês, flanked on either side by the symbols of stability and protection.

The deposit constituted in itself a find of no small interest and value, and for some time our attention was focused entirely on noting and photographing it and on the delicate task of extricating the chair fragments from the tambourine. Not until the position of the base of the headrest was noted was a more important aspect of our discovery revealed. This part of the headrest was wedged between two chunks of limestone at the base of what at first had appeared to be no more than a slight projection in the neighboring rock face but on closer inspection proved to be a separate slab of stone. This was held in place and plastered over with coarse white mortar, unquestionably the blocking of the doorway of an intact tomb.

*Figure 1:* **Tambourine and chair fragments at the blocked entrance to Ra-mose and Hat-nufer's tomb**

The tomb had been made and sealed up just before the commencement of the work on the great tomb above, and shortly afterward the sealed doorway had been buried deep beneath the fill of the artificial terrace thrown out in front of Sen-Mut's forecourt. The position of the newly discovered tomb—squarely in front of the center of that of Sen-Mut—added considerable zest to our speculations as to its occupants.



All illustrations courtesy the Metropolitan Museum of Art

*Figure 2:* **The tambourine was like the one at the right**

The removal of the blocking, effected after its method of construction had been recorded, laid bare a tiny,

*Figure 3:* **Hat-nufer's chair, its cording as fresh as if nearly new**

rectangular doorway flanked by rough jambs of cut limestone, and, behind it, one small rock-cut chamber, 1.3 meters in height, 2.5 meters deep, and 2.9 meters wide. Our first glance through the doorway (Figure 4) opened up no extensive vista, for the eye was immediately confronted by an uninscribed, white Canopic chest, shrine-shaped and mounted on sledge runners (*D* in the plan, Figure 5) and, beside and behind it, a mass of coffins, boxes, baskets, and jars, so tightly packed together and so completely filling the little room that practically no free space remained.

Disregarding for the moment a pair of uninscribed, rectangular coffins, clearly visible on the west side of the chamber, our attention centered on a great black anthropoid coffin which lay just to the right of the line of the doorway and extended northward, back into the gloom beyond (II in Figure 5), and beside it, against the chamber's east wall, another coffin, also anthropoid but much smaller and painted white. Both coffins were covered by a series of linen palls concealing the bands of hieroglyphic inscription with which we knew them to be decorated; but by raising one corner of the pall over the foot end of the black coffin, which lay within arm's reach of the doorway, we were able to read the bottom of the last column of inscription on the near side of the coffin. The title and name were those of the "House-mistress Hat-nufer," and when further preliminary investigation disclosed the name "Ra-mose" on the lid of the white coffin the problem of the ownership of the tomb was solved.

At this point we remembered a small rectangular panel of relief which occupies the center of the stela in Sen-Mut's Deir el Bahri tomb discovered by the Museum's Expedition in the winter of 1926-1927. The panel depicts a family group (Figure 6). At the center sits the great Sen-Mut and beside him his "beloved father," his arm thrown affectionately about his son's shoulder. Facing them is the mother, in her extended right hand an open lotus flower, which she holds in gracious gesture before her son's face. The names written over the heads of the parents in this panel (and appearing elsewhere on monuments of Sen-Mut) are the same as those which we had just read on the coffins in the newly discovered hillside tomb, Ra-mose and Hat-nufer.

The father, Ra-mose, bears no title on his coffin and only rarely on the previously known monuments the no longer functioning courtesy title "dignitary." He was therefore a commoner, probably a peasant, for at this time anyone engaged in the learned professions or associated with the state or religious administration could always summon up a title of some sort with which to grace his name on formal monuments. Hat-nufer, Sen-Mut's mother, likewise appears to have been without special rank. Her name is frequently preceded by the title "house-mistress," but this implies only that she was the senior woman in an independent household. Whatever notice these persons received was due, we may be sure, to the distinguished position of their son—a self-made man in every sense of the expression.

Four days were devoted to the preparations for safeguarding the tomb and

*Figure 4:* **How the tomb of Ra-mose and Hat-nufer appeared when it was first opened**

its contents and for its subsequent clearing. The Director General of the Antiquities Service was duly notified of the discovery; relays of extra guards were arranged; a stout wooden door, which could be securely sealed when nightfall should put an end to each day's work in the chamber, was provided; carrying litters were built for the transport of the bulkier objects; and trays, packing materials, varnishes, and other preservatives were checked over and made ready. The morning of January 16 saw the commencement of the actual clearing, which was accompanied by the keeping of a plan of the chamber record-

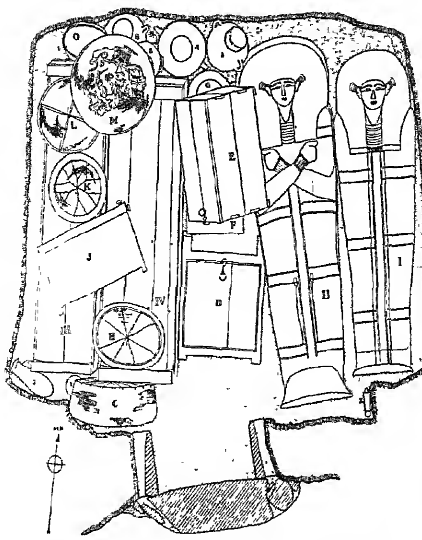


*Figure 5:* **Plan of tomb of Ra-mose and Hat-nufer**

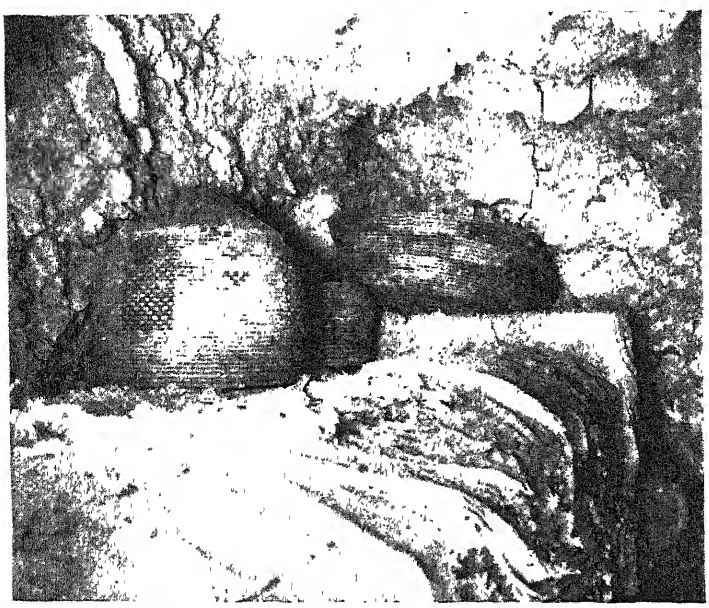


*Figure 7:* **Baskets, perfectly preserved, found on the two rectangular coffins**

ing the position of each object before it was removed (Figure 5), and was constantly interrupted by the taking of photographs of groups of objects in position and by the precautions necessary to ensure the safe removal of the more fragile articles. Fortunately, almost everything found in the tomb (which, situated high up in the desert slope, had completely escaped the ravages of dampness and termites) proved to be in excellent condition; and the clearing was accomplished with ease in five days, the chamber completely emptied by January 21 and its contents stored safely in the Expedition's workroom.

The first item removed was the wreck of a pillow, or bolster, of red leather, stuffed with bulrush down, which, the cover having been extensively eaten by mice, lay spread over the decorated grass basket (*C*, Figures 4 and 5) just to the left of the doorway. This was followed by a pair of sandals of red and yellow leather, also damaged by mice, found tucked in between the lid of basket *C* and the south end of coffin IV, and then by the basket itself. Next came the Canopic box (*D*), the linen chests *E* and *F*, the alabaster and pottery jars, the chest *J*, and the baskets packed on and around the two rectangular coffins (Figure 7). It was necessary to remove these two coffins before those of the owners of the tomb (Figure 8) could be squeezed out through the narrow doorway. Of the latter, Hat-nufer's coffin, of course, preceded that of her husband, the last object cleared.

This is naturally the exact reverse of the order in which the items were orig-

*Figure 6:* **Sen-Mut and his parents, from the stela in Sen-Mut's tomb**

inally inserted into the chamber. Ra-mose's coffin was the first to have been set in place. It was followed in turn by the coffin of Hat-nufer, then by coffin III, and finally coffin IV. The boxes, baskets, and some of the jars, which, as we shall see, were probably the property of Hat-nufer, must have been placed where they were found after the introduction of coffins III and IV.

(*To be continued*)

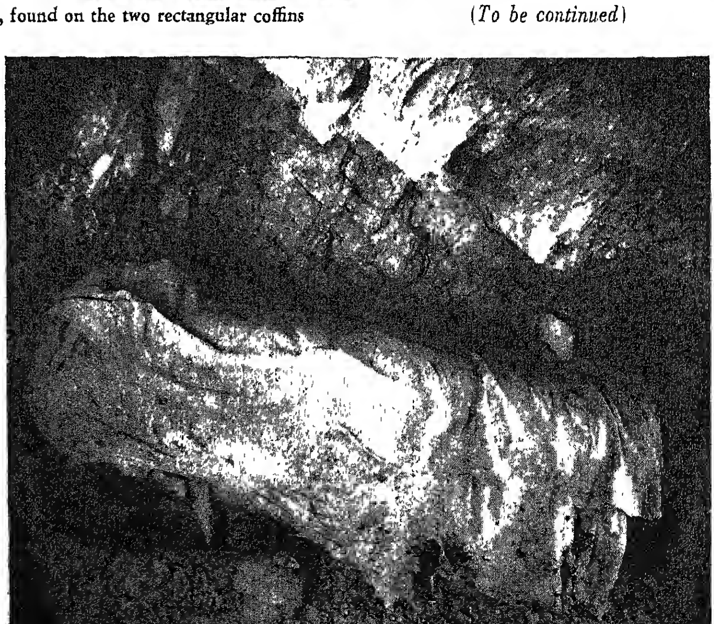
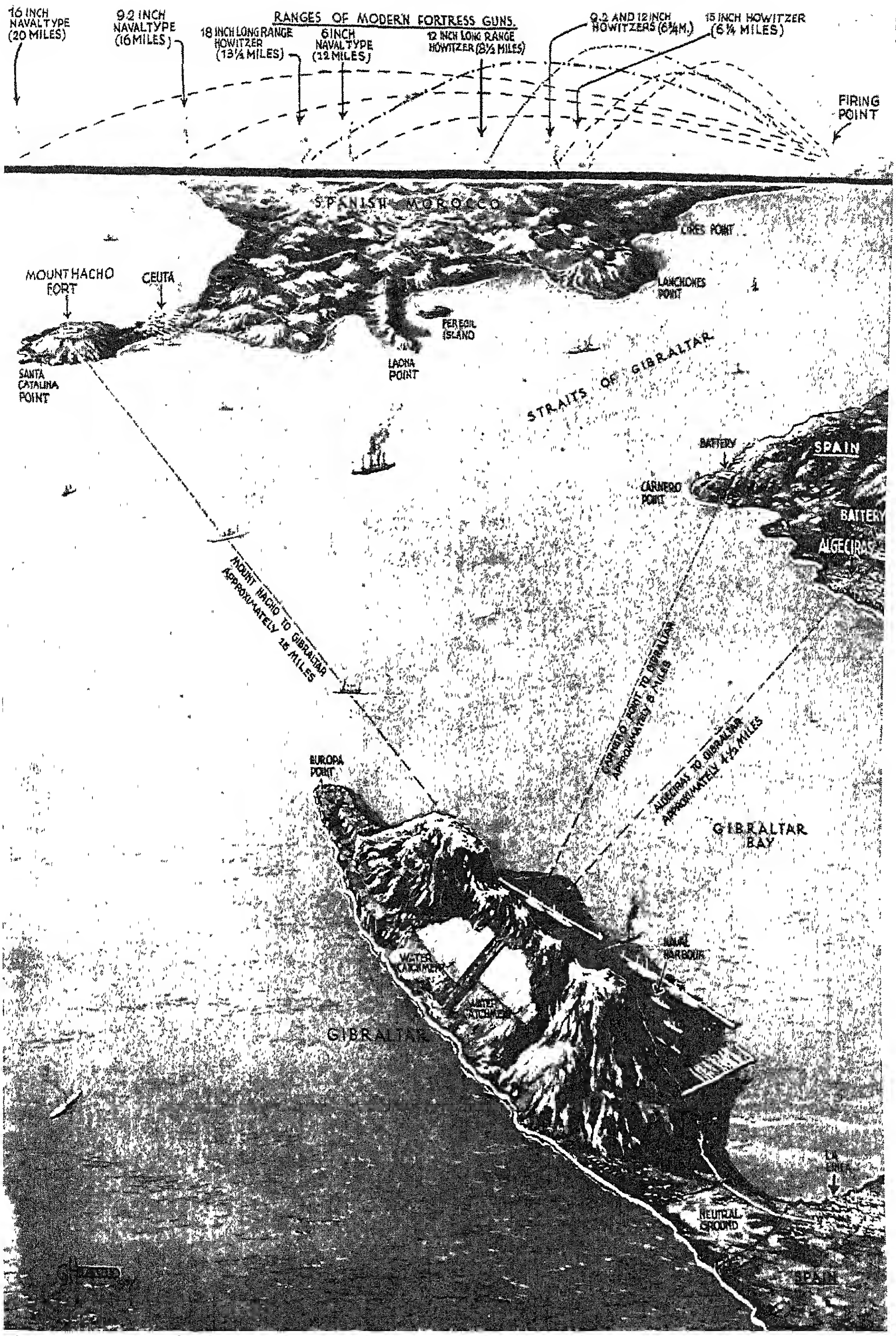


*Figure 8:* **The coffins of Ra-mose and Hat-nufer covered by their palls of linen**




Courtesy *The Illustrated London News*

# THE BATTERIES NEAR GIBRALTAR

TO those who believe that the fortress of Gibraltar stands on an isolated point within the range of naval guns only (and many do have that impression), it will come as a surprise to learn that this is far from the truth. Shore batteries or fortress guns could fire upon the rock from three points of the compass: From the north in Spain; from the west across Gibraltar Bay; and from Spanish Morocco to the south. The rock, under such attacks, would provide scant shelter for its adjoining Naval Harbor (British). The scale of comparative gun ranges at the top gives point to the distances marked on the drawing and show why Great Britain is disturbed over recent reports of fortification of the Spanish and Moroccan coastline. Britishers would like to know what kind of guns are being mounted thus to command their fortress. Note particularly the water catchments by means of which rain water is collected for supplying the garrison.

# COAL-COKING BY ELECTRICITY

## New Electrical Process Makes Coke, Gas, and Tar . . . Cheaper . . . Simpler Retort . . . Can Operate on Off-Peak Power . . . Consumer, Utilities Profit

By H. STEVENS

THE recent enactment by Congress of the Guffey Coal Bill promises to remove the fear of bankruptcy from an industry which has suffered unusually from the economic crises of the early 1930's. Even during the boom days, the coal industry was steadily losing ground. The increasing use of natural gas and oil made great inroads into the fuel market, while developing hydro-electric plants took their share of the business of manufacturing electricity. These conditions were aggravated by the economic slump, with the result that the coal industry has for years been characterized by widespread bankruptcy and unemployment.

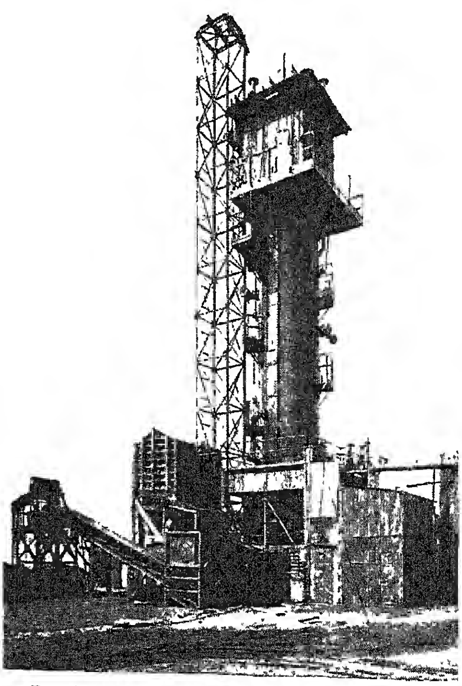
The Guffey bill provides for a National Bituminous Coal Commission which is authorized to investigate new uses for coal which will increase its market. The new process for the electrical carbonization of coal may, conceivably, come in for serious consideration as an economically important use for coal.

Briefly, electrical carbonization of coal is the use of electricity to make coke, gas, and tar from soft coal. In all carbonization processes, coal is heated. When soft coal is heated, it gives off gas and tar and what remains is coke. The electric process differs from others not only in that the heating is done with electricity, but that a mass of coal is heated from within rather than from without.

IN the electric process a mass of 30 tons or more of coal is placed in a retort, with a "starting fuse" as a core. The fuse, consisting of coke particles, is necessary because soft coal is not a good conductor of electricity. Carbonization is begun by passing electricity through this fuse, thus heating it and the surrounding coal to drive off the gas and tar.

The coal immediately surrounding the fuse which thus becomes coke is a better conductor of electricity than the starting fuse. In the starting fuse the resistance to electricity is high because of poor contact between loose coke particles, but the newly formed ring of coke is melted together and makes a continuous path for the electric current. On further heating, this ring of coke shrinks and cracks, but not until a new outer layer of coal is carbonized. Each newly formed tubular ring of coke offers easier passage for the current. In this manner, the heat travels radially outward, always being electrically generated adjacent to the raw coal. This growth continues until the entire mass of coal is carbonized.

The main product of carbonization is coke. The by-products—gas and tar—can be recovered when coal is heated in a retort from which air is excluded. The electric carbonization retort is air-tight, cylindrical in shape, and set up vertically on a steel base raised on concrete piers. The steel retort shell is lined with fire clay brick. Circular steel plates, also fire clay lined, serve as top and bottom covers through which pass the electrodes carrying the current. Only the upper electrode is electrically insulated. Current is supplied to these electrodes through a transformer, and they, in turn, make contact with the starting fuse, establishing an electric circuit.



Detroit Edison gas retort which is also a laboratory for determining the economics of the new process

In actual operation, the bottom cover is first put into place, and the starting fuse of coke particles in a metal pipe is set on the bottom electrode. Then the retort is entirely filled with coal, after which the metal pipe is withdrawn and the top electrode is placed in position. The top cover seals the retort. Electricity is then turned on and the evolution of gas follows immediately. This gas passes through the mass of coal and leaves the retort by suitable outlets, passing into collecting mains. After the coal is carbonized, the top cover is raised and any residual gas is ignited as it escapes. The bottom cover is then opened and the hot coke falls by gravity into the conveyor where it is quenched and loaded directly into railroad cars.

RESULTS from a typical 20-hour run of the 30-ton retort built by The Detroit Edison Company show that from one short ton of moist Pittsburgh seam coal there were obtained 10,000 cubic feet of gas with a heating value of 525 B.t.u. per cubic foot, 15 gallons of tar, and 1400 pounds of coke. These yields are slightly better than the results of tests made by The American Gas Association on Pittsburgh seam coal carbonized in by-product ovens.

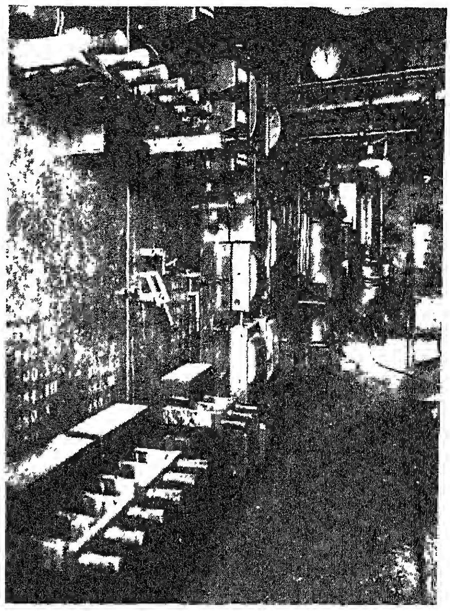
There are several outstanding differences between electric carbonizing and the by-product method now in general use. The main advantage of the electric process is that it utilizes the principle of heating a mass of coal directly from within, whereas in the by-product method the heating is done from the outside. Mass production of coke, gas, and tar is possible in electric carbonizing on a scale many times greater than that of the by-product oven. The electric process uses large-capacity retorts built with a small initial investment. In the by-product method, smaller capacity ovens require greater capital

outlay. In the electric process, maintenance and operating costs are lower and the temperature and rate of heat travel are readily controlled, making for greater flexibility in operation to meet consumers' demands. The advantages of the electric process promises to increase the market for coal.

Nearly all soft coal is burned in one form or another. About one sixth of a normal year's production is carbonized. Practically all of this is done in ovens which permit the recovery of gas and tar, and hence are known as by-product ovens. These originated in Germany 50 years ago, but the principle on which they operate today is basically the same as it was originally. In this system, coal is charged in narrow prismatic ovens. The heat for carbonization is obtained from the combustion of gas and air in flues outside the walls of the ovens. In the by-product method, then, the coal is heated indirectly and from the outside, heat having to travel through heavy brick walls before reaching the coal. The disadvantage as compared with electric carbonization is obvious.

The readily noted differences in the principle of heat generation and application lead to a difference in the capacity of the ovens and retorts. The by-product oven operates most efficiently with its present capacity of 15 tons of coal. The retort of the electric process has a capacity of 30 tons and can be made much larger.

The electric process also has the advantage of requiring a much smaller initial investment. In the first place, the design of the plant is very simple. The electric process does not use the complicated system of vertical and horizontal flues, heat regenerators, burners, and valves required for the by-product oven. Nor is a mechanical pusher necessary for discharging the electric retort. Such a pusher is indispensable with by-product ovens. The elaborateness of these latter ovens may be shown by the fact that over 500 different shapes of brick are needed in their construction, whereas in the electric retort only a dozen different shapes are required. Then there is the matter of ground area to consider. In the by-product oven plant, one eighth of the area is occupied by coal, the balance being taken by the pusher, brick walls, flue, stack, and so on. In the electric process plant, the coal occupies about half the area, the balance being used for retort wall and electrical equipment.

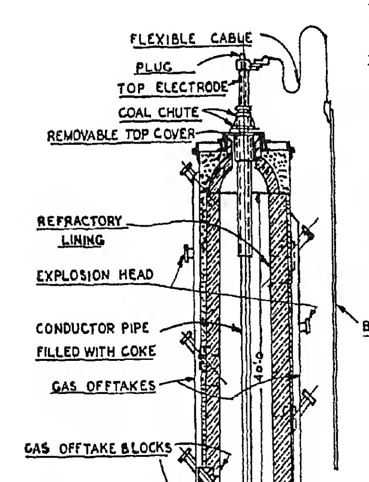


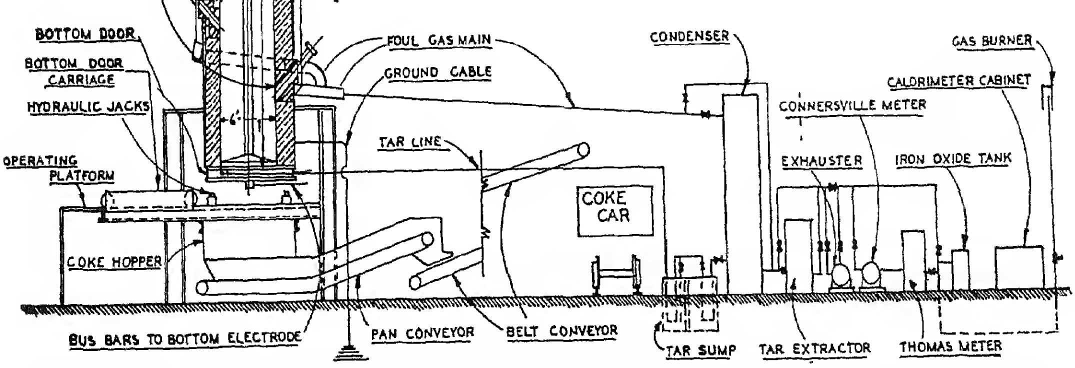
Part of the equipment needed for operating the electrical gas retort: the switchboard

THE maintenance costs are lower in the electric process, because the equipment is not subjected to high temperatures, and the wear and tear on the fire clay brick and electrodes are practically nil. Furthermore, operating costs are lower because electrical operation makes this process practically automatic.

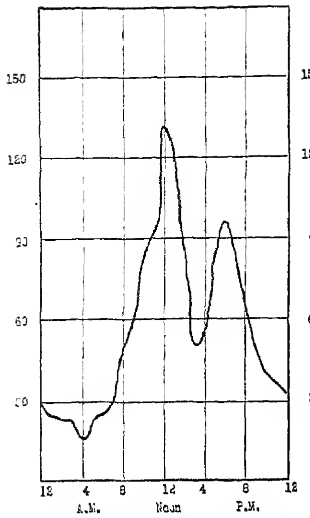
By-product oven walls are built of silica brick which expand enormously on heating, but the use of silica brick is necessary as this material will not soften or melt under the intense external heat necessary in these ovens. Before by-product ovens can be charged with coal, they must be slowly dried out and brought up to a white heat. This takes many months. The rate of heat travel in the by-product oven depends very largely on the thermal conductivity of the silica brick. After the heat passes through the wall, the rate of heat travel in the coal charge averages about one inch per hour—measured on the oven width. The fixed character of the thermal conductivity of silica permits of little control over the rate of heat travel. Also, the enormous mass of brick work will not allow of ready changes in its temperature.

In the electric retort, the current flows through the charge of coal. Heat in the electric process is generated adjacent to the uncoked coal and is accurately controlled by stepping the voltage up or down at the transformer. Thus, rates of heat travel varying between a quarter of an inch and six inches per hour—measured on the retort diameter—have been achieved at will in the electric process. This flexibility of operation means that the electric process can either yield three times as much tar as the by-product method or else make coke six times as fast as the by-product method. The fact that the electric process operates without a preliminary warming up of the retort and that the evolution of






Schematic diagram of the electrical coke plant, with a cross-section of the retort. In charging the retort, a metal pipe filled with coke particles is inserted, the surrounding space is filled with coal, and the pipe withdrawn, leaving the coke behind



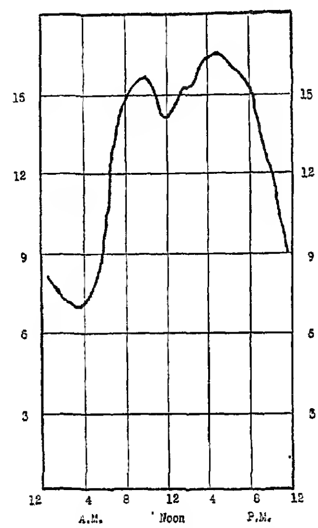

Hourly use of gas in metropolitan areas, *above;* and *right,* hourly use of electricity in U. S. These graphs indicate that the peak of one is in the valley of the other

gas can be started or stopped as often as occasion demands enables the electric process to meet hourly, daily, or seasonal demands of the consumer for gas.

Gas from by-product ovens is contaminated by flue gas leaking into the oven. Generally more than 10 percent (by weight) of by-product oven gas consists of inert gases—carbon dioxide and nitrogen. This dead material affects adversely many qualities of the gas. It also adds to the cost of distributing it. The electric process makes unadulterated coal gas since the retort has a gas-tight welded steel casing and infiltration of air is impossible. Electric process gas can, therefore, be distributed at a lower cost and be used more efficiently than by-product oven gas as it does not carry the excess baggage of burned gas from oven flues.

WITH all these advantages, the electric process requires less fuel to do the carbonizing than is required in the by-product method. Tests made by The American Gas Association showed that, in the by-product method, 292 pounds of *coke* were required to carbonize a ton of Pittsburgh seam coal. To do the same work, the electric process used 350 kilowatt-hours of electricity, the generation of which by steam power requires about 290 pounds of *coal*, a less valuable fuel than coke.

What possibilities does the electrical carbonization of coal offer for future development? Ultimately all technological advancements must be evaluated from the standpoint of the consumer. At present the principal household fuel is coal. The Research Department of the National Coal Association has determined that the user of coal in hand-fired furnaces gets only 45 percent of the heat in the coal. It also determined that the user of coke gets 70 percent of the heat in coke. On a heat value basis, therefore, the consumer should not pay for coke more than one and a half times what he pays for coal. If the use of coke is developed, the change will react to the advantage of both consumer and community since the burning of coke in household furnaces stops the pollution of air by the smoke and soot of soft coal. However, such widespread use depends on market price, which in turn depends on manufacturing costs, and this




in turn depends on mass production. By-product ovens have reached their maximum efficiency in this respect. Mass production in the electric process is achieved by simply using more starting fuses.

Another method for achieving greater mass production and reducing costs in the electric process lies in pre-heating the coal before carbonizing. Pre-heating drives off only moisture from coal, thereby increasing its density which in turn increases the mass of coal that can be charged in the retort. Further heating causes coal to become plastic and swell. Swelling of coal in by-product ovens during carbonization causes grave injury to oven walls, hence pre-heating is not done. However, in the electric process the retort wall is bound with a steel shell which is not distorted from the pressure exerted by swelling coal. Furthermore, such pre-heating reduces the amount of electricity so that only 250 kilowatt-hours are required to carbonize a ton of dried and pre-heated coal. No additional energy is required for pre-heating since this is done by heat now wasted in the steam power electric plant.

Finally, the electric process introduces a feature the significance of which as a means of reducing costs in the manufacture of gas and electricity will become obvious on a moment's consideration. The accompanying graphs show the hourly use of gas and electricity on a week day in winter. Graphs for summer days display lower peaks but the pattern is the same. Graphs for Sundays and holidays show even greater contrast between the use of electricity and gas because these are days of minimum use of electricity and maximum use of gas. All graphs show that with electricity there is a valley at noon when there is a corresponding peak in the use of gas. Despite the midday valley in the demand for electricity, coal must still be burned to keep boilers and turbines ready to carry the afternoon generator load. Therefore, generating equipment stands idle that could otherwise, with but little more coal, generate electricity for making gas the use of which, at midday, amounts to one third of the total used during the day. A reduction in power-plant overhead would naturally follow use of electricity during plant stand-by periods for carbonization of coal.

THE serious defect of electricity is that it cannot be economically stored. Therefore enough generating capacity is needed in power plants to meet peak demands. When the plant is not operating at peak, generating capacity is in disuse. Thus the electric generating capacity of the United States has stood in disuse two thirds of every year for the past 35 years. It is this idle generating capacity, enough to make three times the amount of gas now used, that the electric process seeks to use for the production of coke, tar, and gas.

Gas can be stored commercially to advantage and when hourly consumption is less than production, gas *is* stored. When consumption is greater, the stored gas supplements production. When the seasonal consumption of gas falls off, the electric process would make less gas and more tar. It is by this flexibility of operation that the electric process can make tar and gas to meet the consumer's changing demands. These products will at least partially supplant petroleum from its present secondary use as a heating fuel and return, in like ratio, quantities of petroleum to its primary purpose of supplying motor fuel. This would enable coal to regain at least part of the market it has lost to petroleum.

The electric process has potential significance for several agencies. For the coal industry, it promises additional use for coal by recapturing part of the fuel market from natural gas and petroleum. For the utilities, it offers possibilities of more efficient use of equipment, thereby reducing costs. For the community, it holds the prospect of less polluted environment by encouraging the use of cheap, smokeless fuel. Should these agencies pursue thoroughly the potentialities of the electric process, the results can only react to the advantage of all consumers.

# The Electrical Shotgun

In these days when everything else gets bigger and bigger, scientific instruments are growing too. Champion for size, of course, is the 200-inch telescope, which on a weight-for-weight basis probably exceeds by several times the mass of any other instrument intended for pure scientific research. Its total weight will be in the neighborhood of 500 tons.

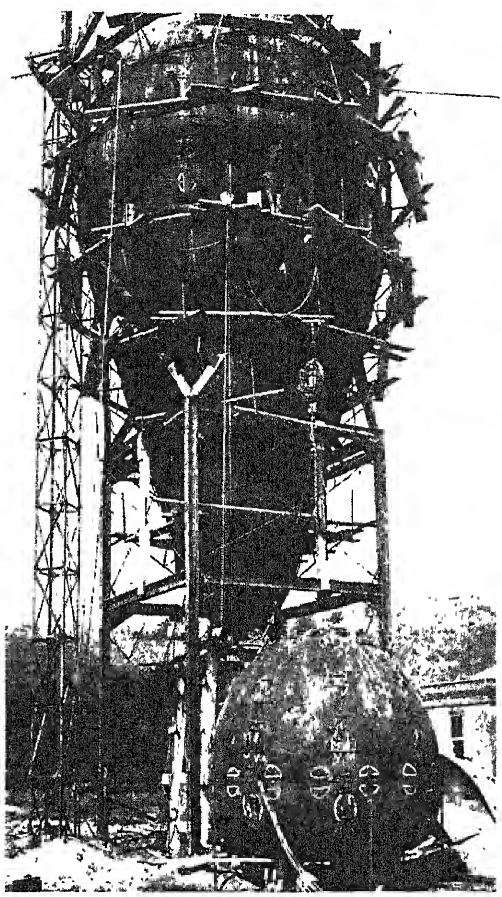
One of the closest runners-up is the "atom smasher" that research engineers of the Westinghouse Electric & Manufacturing Company are building at the company's East Pittsburgh research laboratories. It will stand 65 feet high, atop a two-story laboratory building, and will weigh about 100 tons.

The atom smasher, though one of the biggest scientific instruments, will be engaged in picking apart some of the world's smallest bits of matter. About 500,000 atoms, laid side by side, would be needed to span the breadth of a human hair (of .002 inch diameter). There are about $10^{21}$ (1000 billion billion) atoms in the head of an ordinary metal pin.

These minute motes of matter will be investigated by bombardment with even smaller particles, traveling at velocities of from 30 to 100 million miles an hour. Producing such enormous speeds is the job of the atom smasher, which in reality is an electrical shotgun. The charged bombarding pellets are the "shot"; electricity at extremely high voltage is the "powder."

The outside of the atom smasher is a pear-shaped dome of welded iron, a pressure vessel into which dry air will be pumped at 120 pounds pressure per square inch to serve as insulation.

Nestled within the pear-shaped dome is a mushroom-like metal electrode, on which will be stored a positive electrical charge ranging up to 5,000,000 volts. Extending vertically downward into the laboratory from the electrode is a 30-foot porcelain vacuum tube, in which a series of electrical "lenses" will focus the beam of high-speed particles. Through this tube will stream the bombarding pellets, pushed by the tremendous electrical pressure upon the electrode. Starting at zero velocity, they will fall 30 feet through 5,000,000 volts potential, ending with a speed more than a hundredth that of light.



The Westinghouse "atom smasher." In the foreground is the mushroom-shaped electrode which was placed inside the big shell just before the cap piece was welded on

The discharge of particles will be continuous, the total current being in the neighborhood of a few microamperes. At the lower end of the vacuum tube the particles will pass through an analyser capable of sorting them magnetically into separate beams according to velocity. The material to be bombarded will be placed on the surface of small targets about the size of a five-cent piece at the lower end of the analyser, where thin windows will permit the bombarding pellets to pass from the vacuum into the air.

But why do scientists do all this? What are the results expected? In all probability, no results of immediate commercial value. But worlds of new knowledge, already glimpsed through the nuclear discoveries of Lord Rutherford, Chadwick, the Joliots, and many others, are probably just around the corner for atomic explorers equipped with adequate apparatus, courage, and persistence.

It is impossible to predict today what may come from this research tomorrow. Of immediate interest is the production of "artificial radioactivity" in common substances in sufficient quantity to permit bio-chemical and medical experiments. This can undoubtedly be accomplished now.

The release of usable energy from the atom, and the transmutation of elements in marketable quantity have been subjects of intense speculation. For, although nuclear reactions seem sufficient to explain the source of energy within star interiors as heavier elements are built up from lighter ones, nevertheless atomic power and transmutation in commercial quantity are doubtful indeed, at least now.

"In the present state of our knowledge, available equipment, and experimentally determined efficiencies for nuclear reaction," said a Westinghouse statement recently, "it seems that hope of obtaining atomic or nuclear power, or of obtaining transmutations of one substance into another on a commercial scale, are practically excluded."

This "pessimistic view" is based on a simple little calculation:

1: The efficiency of transmutation is of the order of 1 in $10^7$ bombarding particles. 2: In the beam of the atom smasher (at about one microampere) there are about $10^{12}$ particles per second. 3: Therefore, bombarding a target produces $10^5$ hits per second. 4: One gram (molecular weight) of matter contains $10^{23}$ particles. 5: Consequently, it will require $10^{18}$ seconds to transmute a gram of one element into another—or release the energy in a gram of atoms.

And $10^{18}$ seconds works out to be 31 billion years—too long to wait around!

# RADIATION PRESSURE

## How the Sun and the Stars, Due to the Pressure of Their Light, Ultimately Clean Up the Smaller Particles in Their Own Immediate Neighborhoods

By HENRY NORRIS RUSSELL, Ph.D.

Chairman of the Department of Astronomy and Director of the Observatory at Princeton University. Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington. President of the American Astronomical Society

IT is remarkable that the forces which play almost an exclusive part in controlling the motions of the heavenly bodies appear on earth as feeble influences, which can only be detected, much less measured, with delicate apparatus.

Gravitation itself—though it holds us to the earth with a force which can hardly escape our notice—is so weak, when measured as an attraction between two masses in the laboratory, that its real nature would probably have long gone undetected, were it not for its influence on the motions of the planets and the moon. The reason for this is, of course, that gravitation is really a rather weak force, but the attracting masses dealt with in astronomy are so very big that its influence becomes predominant.

The only other force which has an important influence on motions in our system is so minute that its very existence was first recognized by deduction from theory a generation before laboratory technique became equal to detecting and finally measuring it. This force is radiation pressure. When Maxwell, two generations ago, developed the electromagnetic theory of light, it followed, as a necessary consequence, that a surface upon which a beam of light fell and was absorbed, was subject to a pressure driving it in the direction in which the light moved. But the computed pressure was almost ridiculously small. For full, unobstructed sunlight at the earth's distance, its value, expressed in engineering units, came out 2½ pounds (weight) per square *mile*. Under terrestrial gravity, this pressure would be found at the bottom of a layer of water less than $\frac{1}{30,000,000}$ part of an inch thick. No wonder this pressure is hard to measure! Why, indeed, should it produce any observable effects in the heavens above, or the earth beneath?

Well, we have hardly started with a fair case. We should have exposed our imaginary layer of water to the attraction of the sun at the earth's distance —which is only $\frac{1}{1659}$ as great as that of the earth for a particle at its surface. This increases the thickness of our layer to $\frac{1}{33,000}$ of an inch. Such a film of water—about thick enough to show good colors in a soap-bubble—would be pushed away from the sun by the pressure of its light as strongly as it was attracted by the sun's gravitation, and would move through space as if the sun were not there.

Of course a soap-bubble could not exist in interplanetary space—it would evaporate and vanish into vapor in the twinkling of an eye. But a sufficiently thin film of glass or metal might last indefinitely—and the sun would not appear to attract it. Break the film into fragments and each separate bit would behave in the same way (unless by ill luck it turned edgewise to the sunlight). Grind it into fine dust and the particles would be buoyed up by the light, no matter which way they faced. Indeed, the finer fragments, smaller than the original thickness, would be repelled by the sun's radiation more than they were attracted by its gravitation, and would be blown away into interstellar space.

Individual molecules, or atoms of gas, would be even more strongly repelled, provided that their absorption lines lay in a part of the spectrum where sunlight is strong.

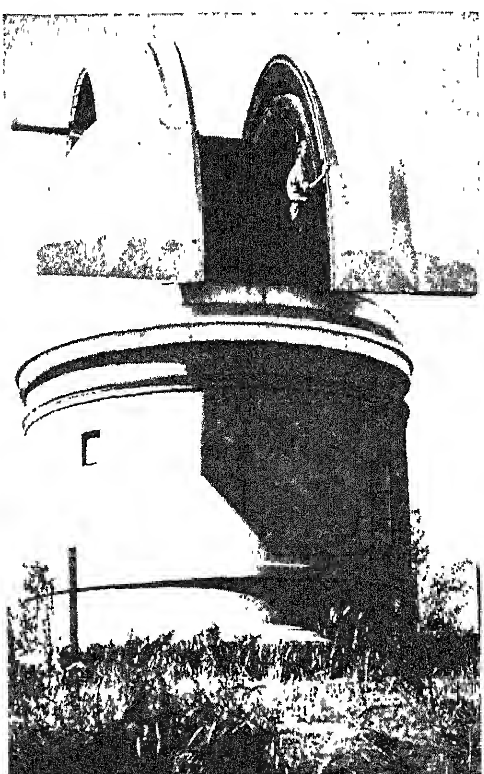


Photo by Wilson Hole

**Already built, before the 200-inch, and in use on Mt. Polomar, is an observatory with an *f*/2 Schmidt**

It is an old story how this repulsive force drives the material of a comet's tail away from the head, and dissipates it into space, in the form of a long streamer. Similar forces probably bear a great part in the ejection of the eruptive prominences which are often observed to escape from the sun.

These familiar effects of radiation pressure are at times very conspicuous; but it should be emphasized that they operate only on exceedingly minute particles. A speck of dust too small to be felt as grit between the teeth might still be so large that, if it were set moving around the sun, gravitation would greatly exceed radiation pressure, and it would have an orbit of quite the familiar sort. To pursue the possibilities we must apply more delicate tests. One of these has long been known.

For a spherical particle of ordinary rock, a millimeter in diameter, the sun's radiation pressure is $\frac{1}{2400}$ as great as gravity. (It does not matter what the distance is; the two change in the same proportion.) A swarm of such particles might pursue an elliptical orbit around the sun, like any planet or comet; but the sun's attraction on it would be weakened, and hence, in order to complete its circuit in the observed period, it would have to be nearer the sun by $\frac{1}{7200}$ part than the distance calcu-

lated by Kepler's Law. A difference as large as this could easily be detected, if we had good observations covering several revolutions. Nothing of the sort has been found for any actual comet, and it may therefore be concluded that the separate particles of the swarm composing the comets' heads average at least a considerable fraction of an inch in diameter.

A much more recondite, but very interesting, result of radiation pressure has recently been discussed by H. P. Robertson. In 1903, Poynting, discussing "radiation pressure in the solar system," concluded that, in the course of ages, it would cause the orbits of small bodies (such as those just discussed) to shrink, and approach the sun.

Poynting's calculations antedated the theory of relativity. They have been re-examined by Professor Robertson (an expert in the field) and the older conclusions are confirmed (with numerical modifications). He finds that the nature of the process can be understood by quite simple reasoning (which leads to the same result as the precise methods of advanced analysis).

One of the fundamental principles of relativity is that energy possesses mass. A particle near the sun, and revolving about it in an orbit, is continually receiving energy from the sun's light and heat. It would therefore grow more massive, if it were not radiating this energy away again into space from its own warm surface. Actually, a balance is soon struck, and the mass of the particle remains unchanged. But the moving energy also carries momentum; and we must account for this too. Absorbed by the particle, it impels it away from the sun—and this is exactly what produces the radiation pressure which we have been discussing. For a particle moving in a circular orbit, the whole effect is to diminish slightly the sun's effective gravitation. In an elliptical orbit, when the particle is receding from the sun, it is running away from the light-source, and gets less energy per second, and hence a little less radiation pressure. Gravitation is unaltered; hence the net attraction is very slightly greater when the body is receding—and correspondingly greater when it is approaching the sun. The effect of this is to cause the eccentric orbit, very slowly, to become more nearly circular.

BUT this is not the whole story. The particle is radiating energy away into space as fast as it receives it, and therefore getting rid of momentum too. If—as is reasonable to suppose—it is radiating energy equally in all directions, this would not by itself alter either the direction or rate of its motion. After the loss of (say) a billionth part of its mass, it would have lost a billionth part of its own momentum, and the velocity of the remaining portion would be unaltered. But during this time it has got back the same amount of mass by radiation from the sun, so that its mass is the same as at the start, but its momentum a billionth part less. Its orbital velocity will therefore be decreased by a billionth part. We must remember that the effect of the momentum communicated to the particle by the incident

Photo by Macpherson Hole, Jr.

**Dr. Joseph J. Johnson, of the California Institute of Technology, and the new 18-inch Schmidt camera housed in the observatory opposite. The Schmidt camera is a purely photographic telescope—that is, it could not be used visually even if this were desired—having a very short focal ratio and therefore a high "speed." The focal ratio of the one shown is $f/2$, and its aperture 18 inches. To make an objective lens of this diameter, and ordinary focal ratio, is not unusually difficult but it would be surpassingly difficult to make it in very short focal ratio. Therefore a mirror is substituted. However, a paraboloidal mirror distorts except at its center but, by adding a thin correcting plate, Schmidt overcame this**

sunlight has already been fully allowed for.

This additional effect is of great importance, because it is cumulative with advancing time. Its influence on the orbit is similar to the long-familiar one of a resisting medium.

The orbit slowly diminishes in radius, and the particle approaches the sun along a very closely-wound spiral. At the same time the eccentricity diminishes—this effect being added to the one previously described. As the particle approaches the sun, it moves faster—having gained more energy from falling toward the sun than it has lost along with its momentum—and the changes in its orbit become more rapid. Finally it falls into the sun—there is no escape.

The rate at which all these things happen depends, of course, on the rate at which mass and momentum "flow through" the particle. At first, one might expect it to be excessively slow. One gram of energy is $c^2$ ergs (where $c$ is the velocity of light), or $9 \times 10^{20}$ ergs. Sunlight at the earth's distance carries $1.35 \times 10^6$ ergs per second through one square centimeter. To get one gram at this rate would require $6.67 \times 10^{14}$ seconds, or 21,200,000 years. A particle of one gram mass, and one square centimeter cross-section, at the earth's distance, would therefore have an amount of energy equal to its whole mass flow through it in 21,000,000 years; and we should expect very radical changes in its orbit within this time.

Allowing for the more rapid changes near the sun, Robertson finds that a particle of rock (density 2.7) one centimeter in diameter, started at the earth's distance, would fall into the sun in 10,000,000 years. The time of fall is proportional jointly to the diameter of the particle, its density, and to the square of the initial distance. This has important consequences. The earth has been in existence for at least 2,000,000,000 years. In this time, any masses of rock less than six feet in diameter, originally circulating within the earth's orbit, would have been cast into the sun by the slow but unceasing influence of its radiation pressure. This cleaning-up process would, in the same time, get rid of anything less than three inches in diameter, as far as Jupiter's orbit, and clean out stuff a tenth of an inch in diameter as far as Neptune.

THIS seems inconsistent with the existence of the vast numbers of shooting stars which fall daily upon the earth; but many of these have high velocities and have entered the solar system from outside, while others have elongated orbits and, like the comets of short period, may have been deviated into these, by planetary perturbations, from much larger orbits, within a few millions of years.

The particles which reflect the zodiacal light are grouped around the sun in such a way as to suggest that they are moving in orbits of small eccentricity. If so, they must either be fairly large, or of more recent origin than the planets.

At greater distances, such as the dimensions of the diffuse nebulae, this process would be too slow to be effective, so that there is no difficulty in the observed existence of reflecting and obscuring clouds "near" bright stars—that is, at distances of a small fraction of a light-year. Each star should clean up a small hole in the dust-clouds, in its immediate neighborhood—and this fits the facts, since otherwise the nebulae would brighten up greatly close to the stars—which they do not.

*—Jamestown, Rhode Island, September 1, 1937.*

# Weather and Sunspots

## Though the Skein is Tangled, Long-Range Weather Investigators are Working Toward a Knowledge of the Connection between the Weather and the Sun

By HARLAN T. STETSON, Ph.D.
The Massachusetts Institute of Technology

**THE economic value to the earth's inhabitants of a really dependable method of knowing the weather months in advance, much as we now know we can rely on astronomical prediction, would run *high* into the billions each year. This is one reason why so many have striven to work out systems of long-range weather prediction: it would be an all-time high in practical human attainment. Unfortunately, this task is not as simple as it sometimes seems to some who at first dig into the subject—it is everything that simple is not, in fact. The multiple factors and forces that determine the weather are almost as complex as those which determine the daily events of our lives. Yet, if this vast problem is ever solved, how altered life on this planet will be! The accompanying article is substantially the same as a chapter in the author's book, "Sunspots and Their Effects," shortly to be published.—*The Editor.***

THE trite remark, often attributed to Mark Twain, that "the weather is something that everybody talks about but nobody does anything about," is perhaps less pertinent today than ever. People are becoming more and more concerned with the weather and its prediction. The impetus given to investigations in meteorology by the exacting demands of air navigation promises to open a new era in meteorology. Weather stations at every airport not only demand trained meteorologists but demand of them powers for predicting weather for which the world finds itself suddenly unprepared.

The conventional weather forecasting of yesterday, which has depended largely upon telegraphic communications from the western states, is not satisfying the need of today. Even well-developed storms in the far west cannot always be counted upon to pursue their prescribed paths eastward. Science is seeking new information about the developments and movements of storm areas. For this reason the last few years have seen the initiation of daily airplane flights into the upper atmosphere to find out the actual conditions off the earth as well as on it; a storm area, after all, is a three-dimensional thing.

THE Weather Bureau for several years has tried to meet the demand for forecasting weather more than a single day in advance, and it now attempts forecasts for a weekly period at a time. Business and transportation lines, however, would like to know, not a week but months and often a year in advance, so that they may judge their demands accordingly. While the United States Government has placed the Weather Bureau on a sound basis and is arranging its program according to the latest developments in meteorological thinking, the Department of Agriculture has been appropriating thousands of dollars during the last few years to investigate the possibilities of long-range weather forecasting along many non-conventional lines. Aside from government agencies, various individuals from time to time have established private forecasting services based on conceptions which are not ordinarily recognized as conventional, but which, according to their own enthusiasm, have proved at least as accurate as others in predicting weather at long range.

The idea that weather may be associated with sunspots is not in itself new. Many investigators have attempted to find relationships between sunspots and weather changes, with the ultimate hope that, since we can predict with reasonable accuracy the main trends in the solar cycle, we shall be able to predict likewise the main trends in the changes of weather. Evidently the relationship between weather and sunspots is not a simple one, else the secret would have been found before now.

In spite of many conflicting findings, it appears that, in general, the temperature of the world at large is somewhat higher at sunspot minimum than at sunspot maximum. This seems at first paradoxical, since we might well expect that at sunspot maximum the sun would send us somewhat more heat and radiation than at sunspot minimum. Many of the observations of Dr. Abbot, especially during the earlier years, seem to corroborate this. It is not unthinkable, however, that the surface temperature of the globe could be actually cooler in some years, even though the earth is actually receiving more heat from the sun. Increased heat may produce increased evaporation, which, in turn, will result in increased rainfall. The increased rainfall actually lowers the temperature of the earth's surface and, again by evaporation, the air continues to cool immediately above the earth's surface. Then, of course, as the air is warmed near the surface of the earth, it rises and the cold air comes in from northern regions with its chilling effect. So it is entirely possible that even an increase in the heat received by the earth from the sun may result in increased circulation in the earth's atmosphere that, so far as surface conditions are concerned, can actually bring about lower air temperatures in selected regions than would otherwise be the case.

ONE certain thing is that all the weather on the earth is produced by the sun. It is the sun, shining over the tropical region, which heats the large masses of air in the region of the earth's equator. These masses of warm air ascend, while the cold air from the polar regions spreads toward the equator to fill the place occupied by the ever-rising warmed air. Due to the rotation of the earth, whirlpools and eddies are formed in these air currents, which result in winds and storms that bring our variable weather. So far as changes in the sun's radiation affect the general circulation of the atmosphere, it certainly is to be expected that such changes will ultimately affect the formation of the storms and the storm tracks that result. One of the difficulties in establishing any intimate connection between weather and sunspots is that our observations of weather have to be very local.

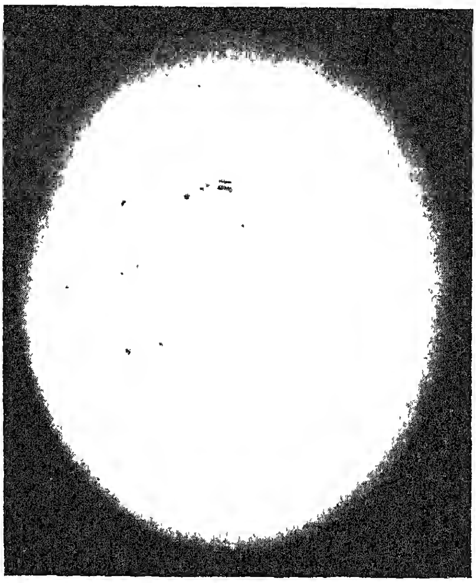
If one averages the weather conditions over the entire globe—as, for example, comparing the average rainfall recorded at observing stations throughout the world—one might at first thought expect

to find some relation with sunspots, assuming that sunspots have anything to do with weather phenomena. Such, however, is far from the case. A storm in one region of the globe means clear weather elsewhere, and a region of excessive rainfall in a given year will usually be offset by one of extreme dryness occurring somewhere else. To average together such effects leads to no definite conclusion. Furthermore, since storms travel over more or less defined tracks, the very migration of these storm centers makes it quite impossible to get significant results even from hundreds of stations scattered from the polar regions to the equator. Yet, if progress is to be made, it will come through a consideration of the distribution of weather as a whole over the entire globe. With a more accurate picture of world weather, indications for weather in a restricted locality for any given time may be more easily understood.

One of the most interesting personalities who has spent a lifetime in the investigation of world weather and its possible relation to the sun, is H. Helm Clayton of Canton, Massachusetts. Mr. Clayton is a well-known scientist who has spent many long years in the Weather Bureau service, and has been remarkably successful in his long-range forecasting. While Mr. Clayton takes cognizance of all the usual meteorological data employed by the government officials, he has utilized his long years of fundamental study of world weather in analyzing certain well-defined cycles which his keen perception has noted as fundamental in the recurrence of storms, rainfall, clear weather, and cold waves.

Mr. Clayton is a firm believer that changes in the sun are accompanied by the fundamental changes in the earth's atmosphere, and has found certain definite indications that changes in the earth's atmosphere in different parts of the world accompany the appearance and disappearance of sunspots throughout the 11-year cycle. He has not only shown certain definite relations between temperatures and sunspots over definite areas of the globe, but he has shown why many investigators have failed to find such a relationship.

Looking at the weather on a world-wide scale, Clayton has found not only that pressures see-saw from one region to another, but he has noted that the way in which they see-saw depends upon sunspots. He finds that there is an opposite trend over the continents and oceans in summer as compared with winter, and that the trend is different in the equatorial regions from what it is in extra-tropical belts. In the equatorial region, the temperatures are distinctly lower at sunspot maximum and higher at sunspot minimum. The same is true in the north and south temperate zones, but in the arid sub-tropical regions, the temperature actually averages a little higher around a sunspot maximum than around a sunspot minimum.



Photograph of the sun, made at the Cook Observatory, by means of the 40-foot photo-heliograph

Mr. Clayton has examined the snowfall records at the Blue Hill Observatory in Massachusetts, and finds 40 percent more snow at sunspot maxima than at sunspot minima. He has traced the records of ice from the Arctic and Antarctic, and finds two to three times as many icebergs at sunspot maximum as compared with sunspot minimum. This corroborates the findings of other investigators who have come to the conclusion that temperatures, at least in the temperate zones, are colder when sunspots are most numerous.

From a careful study of precipitation records selected over the whole globe, he has mapped the world into regions which show greater rainfall when sunspots are most numerous, and regions where rainfall is actually deficient at the same time. While the North Atlantic shows 10 to 20 percent more precipitation in years of greater sunspots, the eastern half of the United States is in the region where the rainfall is actually less during maximum activity on the sun.

South America, Africa, India, and Australia all show again 10 to 20 percent more rainfall during sunspot maxima than during sunspot minima. From a survey of world weather Mr. Clayton has drawn the conclusion that at sunspot maximum the atmospheric pressure is less at the equator than it is during the years when sunspots are infrequent. But this area of lessened atmospheric pressure at the equator is compensated by a zone of greater pressure at sunspot maximum than at sunspot minimum in the northern hemisphere. Any wholesale change in the distribution of atmospheric pressure or barometer readings over the globe, which follows the sunspot cycle, must ultimately affect the number, intensity, and the nature of the storm tracks over the United States or other typical regions of the globe.

This has led Professor Kullmer of Syracuse University to investigate the tracks of storms over the United States during the years when sunspots were in evidence, as compared with the years when sunspots were lacking. On the basis of five solar cycles he has found that there appears to be a shift in the storm tracks of the United States which corresponds very much to the shift in the location of sunspots on the surface of the sun. Furthermore, examining years of solar and meteorological data, he has found on the average 40 percent more storms passing over the fundamental storm track of North America during sunspot maxima than pass over this same region during years of sunspot minima. He based his studies on records extending from 1883 to 1913.

Many investigations have been made of the relationship between sunspots and tropical hurricanes on the earth. Wolf, who was one of the earliest investigators of sunspots, has shown that, during years of maximum sunspots, there has been an average of six to eight violent hurricanes per year, while the average during sunspot minimum is only one or two per year. During the years of sunspots more than three times as many hurricanes have visited the Bay of Bengal in the Arabian Sea. The South Indian Ocean in the same period showed an increase of 65 percent in the numbers of such hurricanes. Reverse conditions, however, were indicated for the South Pacific Ocean, where the number of tropical hurricanes was twice as many during the years of low sunspots as during the years of high sunspots. Other investigations have indicated that, as the sunspot cycle progresses, the longitude of the West Indian hurricanes drifts from 59° W. to that of 88° W.

All of this shows that weather is a highly complex phenomenon which depends upon turbulent air currents traveling in different directions, influenced by continents and oceans, equatorial heat and arctic cold. To upset the balance of one

of these regions may change the character and sequence of any of these phenomena in any of the other regions.

Mr. Clayton concludes that all our weather is the result of progressive, wave-like movements of certain disturbed areas originating in different parts of the world. He finds that, during each cycle of change in solar activity, the centers of high barometric pressure move from high latitudes to low latitudes and back again. The speed with which these waves progress appears to be inversely proportional to the length of the period of oscillation.

This noted investigator finds there will be several years when the differences in barometric pressure between the equatorial region and the north temperate zone become greater than normal, and this period will be followed by several years when the pressure differences become less than normal. The shifting of these centers of action is found to be definitely associated with sunspots. His conclusions are based on so large an amount of data and upon such a wide experience in meteorology that no one interested in weather and weather prediction can overlook the important contributions which Mr. Clayton has made.

Dr. Abbot of the Smithsonian Institution, whose painstaking work of measuring solar radiation we have already discussed, concurs with Mr. Clayton in the belief that, if there are no variations in the sun's radiation, atmospheric movements would soon be reduced to a stable system with periodic exchanges of air between the equator and the pole, and between the ocean and the land. Without variation in the sun, these exchanges would depend mainly upon the variation of the heat received by the earth due to day and night, and to the seasons. These would be set into operation merely by the relative motions of the earth as it turns on its axis and journeys about the sun. Both Abbot and Clayton firmly believe that the existing abnormal changes in weather which we experience have their chief source of origin in variations of the sun itself.

DR. ABBOT'S long investigations of solar variations and weather at the Smithsonian Institution have convinced him that the sunspot period is an important factor in untangling the vagaries of the weather. He finds that the variations in the sun's heat and in the weather really appear to comprise 12 or more regular periods, the most conspicuous of which is a period of 23 years, equal to twice the average sunspot cycle. Observations show that when we are concerned with the electrical nature of sunspots, 23 years really elapse between the recurrence of sunspot cycles of the same kind. The examination of weather records at strategic points, Dr. Abbot says, shows very definitely this long period of weather variation covering 23 years.

One puzzling difficulty in all these investigations has been that a definite relationship between sunspots and weather appears to persist for a considerable number of years, then the relationship gets out of step and changes its phase. Then, for one reason or another, over a considerable time, the weather effects will run just opposite to the expected.

Dr. Abbot now has new light on this puzzling difficulty. In examining weather records from 1875 to 1925, he has discovered that in the 11-month variations of temperature at a selected station the temperature rises with increasing sunspots if the numbers of sunspots are not large. When, however, sunspots approach a maximum, the increase in temperature follows the increase in sunspots less markedly. During the years when sunspots are very large and most numerous, the temperature actually appears to fall with increasing numbers of sunspots. We might interpret this as meaning that there is a certain optimum of sunspots for normal weather conditions. If sunspots are less than this amount, we get one effect, whereas if they are more than this amount, the opposite effect results.

We might take as an example the dependence of one's working efficiency upon temperature. Let us say that your optimum working room temperature is 68 degrees, Fahrenheit. You come into the office some winter morning and find it is only 60 degrees, with the thermometer slowly climbing. As the thermometer rises, you literally warm up to your work, and perform it more efficiently. If, however, through lack of proper heat control, the thermometer continues to rise to 80 degrees and above, you begin to slow down again. If your experience with temperature and working efficiency had been limited entirely to a range between, say, 50 and 70 degrees Fahrenheit, you would have derived the law that, as temperature increases, your working efficiency increases. It might have been a bit of a jolt the first time you were subjected to temperatures of 80 degrees, 90 degrees, or above, to discover that, as the thermometer continued to rise, your ability to perform your duties and create new ideas actually diminished.

This may serve as an example of the relationships between sunspots and the weather. With sunspots below some critical value, temperatures on the earth seem to go up with increasing sunspots. With sunspots above this critical and optimum level, temperatures on the earth react in the opposite manner, very much as your mental efficiency ran opposite with the thermometer in the illustration we have used.

DR. ABBOT has traced the 23-year variation in the weather, with many of the minor fluctuations which occur at greater and less intervals, in the tree-ring data studied by Dr. Douglass; also in the flow of the Nile River, the level of the Great Lakes, the rainfall in southern New England, and even in the abundance of cod and mackerel.

Another independent record of the 23-year cycle is evident, according to Dr. Abbot, from the records of varves, those curious laminated markings on sedimentary deposits that may be traced through geologic time. The annual character of the layers of these clay-like deposits aroused Professor Douglass' interest in analyzing the spacings. So he studied their records, very much as he analyzed the rings in the trees of the forests of the Southwest. Professor Douglass finds a very prominent cycle in varves of 11.4 years, which is practically the sunspot cycle. Of course, two of these so-called "Hellman cycles" are the equivalent of Dr. Abbot's 23-year period. Various other cycles have been traced in sedimentary deposits extending back over 1400 years.

It is the 23-year period which Dr. Abbot believes is particularly important in weather and climate forecasts. He finds departures both in temperature and rainfall which have repeated themselves remarkably in these intervals. Dr. Abbot says the United States is now nearing the close of a period of considerable drought which, according to his best estimate, will not return until the year 1975. He bases his prediction

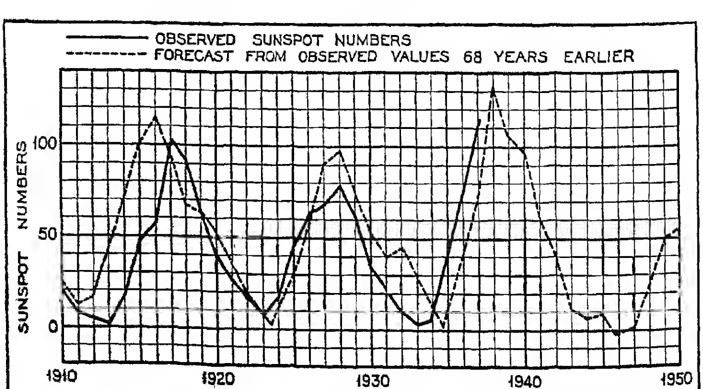



*Figure 1:* **A forecast of sunspots, from Clayton's 68-year period (see the text)**

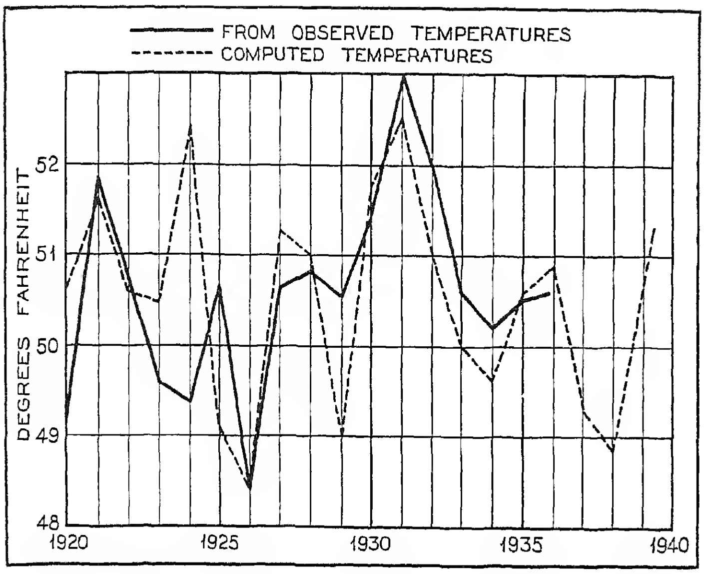



*Figure 2:* Clayton's forecast of mean annual temperatures at New Haven, Conn.

on twice the solar cycle in records of both solar activity and weather. He finds this double period particularly important to precipitation.

Both the 23-year and the 46-year cycles are traced in temperature departures from normal, not only in the United States, but in western Europe, southern Africa, and Australia. On the basis of the past, he has at several times made forecasts which subsequent experience has shown to be remarkably well verified. If more observing stations could be established for the exact measurements of solar radiation—particularly if recorders could be sent into the stratosphere regularly every day by means of balloons, in accordance with his suggestion—it appears that so much more satisfactory observations of solar radiation would be obtained as to advance materially the whole subject of long-range weather prediction.

IF weather depends upon sunspots, then the desirability of predicting coming maxima and minima of solar activity becomes of the greatest public interest. The question of the moment is, when is the next sunspot maximum due?

If the answer to this question were as simple as adding the 11 years—the *average* length of the solar cycle—to the date of the last maximum, the answer would be as easy as two and two. The next sunspot maximum would then be due in 1939.

There are good reasons, however, for believing that this is not the best prediction. I have just been examining the records of the last 180 years of sunspots. In this interval there have been 16 completed cycles since the well-determined minimum of 1755. The average length of time from one sunspot maximum to the next over this interval is 11.13 years. It is a surprise, and a bit disconcerting, to find only four maxima of the last 16 have fallen within 11 years of each other. Three have been spaced 13 years apart, three 10 years apart, and two at 12-year intervals. Two others were separated by eight years, and there was one instance of 16 years elapsing between two adjacent sunspot maxima.

On these grounds alone there would be a chance that the next sunspot maximum might follow anywhere from eight to 16 years after the last maximum, which occurred in July, 1928. There is only one chance in four that the 11-year interval will work for predicting the present coming maximum.

Someone with a gambling instinct may like to put stakes on the year of the coming sunspot peak. Surely the exciting variations in spots from one week to the next, as they surge up and down on the way to the top, should give one all the thrills of watching a favorite horse go over the line.

Years have been spent by numerous investigators in analyzing sunspot curves to discover the various periodicities that may enter into the question. When we examine the sunspot numbers month by month rather than year by year, it is important to note that there are secondary fluctuations that occur at more or less irregular intervals. These secondary or minor fluctuations have an important bearing on the prediction of the maxima. Some of these intervals of variation are much longer than the 11-year cycle. Others are shorter.

The most recent and fruitful results which I have yet seen in an attempt to analyze the sunspot cycle into workable periods which may be used for prediction are those recently shown me by Mr. Clayton. By a rather novel trick he has treated the long record of sunspot numbers from 1750, and has determined significant periods of 8½ years, 10 years, 11⅓ years, 14 years, 17 years, 23 years, 34 years, and 68 years. He finds that, from 1750 to 1910, an interval of 68 years gives a close approximation to sunspot changes. Utilizing the dates of all the well-determined sunspot maxima and minima published by Wolf and his successor at Zürich, he finds that the mean interval between nine minima is 68.0 years and that the mean interval between nine maxima is 67.3 years. Using these intervals of about 68 years, and utilizing only data up until 1910, he has made a forecast of sunspot numbers from 1910 to 1954 (Figure 1). This curve agrees so remarkably with the observed values from 1910 to date that it merits more confidence than any prediction which I have yet seen.

ON the basis of his idea that weather is linked with sunspots, Mr. Clayton has treated the annual mean temperatures and rainfall for intervals of 68 years and the fractions of this period previously mentioned. Owing to the great variability of weather changes, he has found it necessary to make frequent corrections to the weather period, in order to obtain detailed correspondence between forecasted and observed temperatures. Utilizing the method of smoothing outlined by him in a recent number of the *United States Weather Review*, he has made a forecast of New Haven temperatures from 1920-1940 (Figure 2). The remarkable correspondence between the forecast temperatures and those actually observed, from 1920 to date, certainly merits some confidence for the prediction of the next decade. Evidently New England is in for some below-normal temperatures for the next two or three years.

However complex and conflicting the results of various investigators who have attempted to link weather with sunspots, it appears that enough evidence has been presented so that one may feel fairly confident that future investigations will bring to light more and more support for the hypothesis of a connection between the weather and the sun. We may hope for the justification of the statement made 40 years ago by the pioneer investigator of the sun, Professor Langley, in his report of the Mount Whitney expedition:

"If the observation of the amount of heat the sun sends the earth is among the most important and difficult in astronomical physics, it may also be termed the fundamental problem of meteorology, nearly all of whose phenomena would become predictable if we knew both the original quantity and kind of this heat; how it affects the constituents of the atmosphere on its passage earthward; how much of it reaches the soil; how through the aid of the atmosphere it maintains the surface temperature of this planet, and how in diminished quantity and altered kind it is finally returned to outer space."

# PLATINUM IN OVERALLS

## Noble Metal Is Industrial Worker . . . So Are Its Five Relatives . . . Resistance to Corrosion and to Spark Erosion . . . Has Excellent Machinability

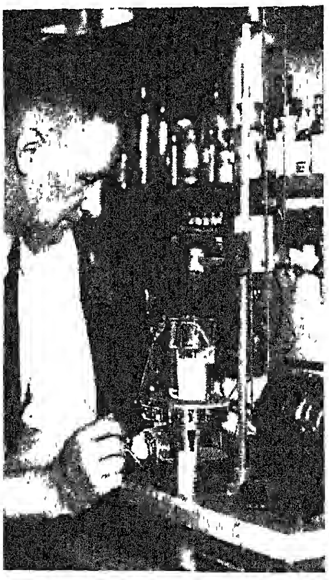
By A. J. WADHAMS
Vice President and Manager of Development and Research Department, The International Nickel Company, Inc *

PLATINUM is no newcomer; although the ancients, with the possible exception of the Peruvians, knew nothing of platinum, a strange ore of unknown nature was found in the New World, about 1538, in what is now Colombia. It was not until 1741, however, when William Wood carried a sample of the new ore to England, that much was learned about it. Even now, the young man who takes his fiancée to the jeweler to select her platinum engagement ring little guesses that on this rare precious metal, the destinies of nations depend. This same young man, unless by chance he is a metallurgist, would probably be surprised to know that the metal with which he binds his troth and with which just this year a queen has been crowned, has for several years been used in alloys to crown many a tooth, is a friend to the farmer, and a vital necessity to the whole world's aircraft, its telephones, its radios, and even to much of its clothing.

But it is only after centuries of ignorance and years of searching in quest of its true nature, that platinum has attained this remarkably useful position. For many years after its discovery in South America the metal was little known in Europe, largely because the Spanish government would not permit its exportation from Colombia. It was first named "platina del Pinto," platina being the diminutive of plata, the Spanish for silver, and Pinto being the name of the river in the sands of which the metal was first found. Now platinum is found widely dispersed but in only minute quantities in ore bodies as well as in river bottoms, and it still remains one of the rarer elements of the earth's surface, being a hundred times rarer than gold.

IN 1752, Sheffer found that platinum could be dissolved in aqua regia, a mixture of one part nitric acid and three parts hydrochloric acid. Then, in 1757, Margraff discovered that the metal could be precipitated from this solution by adding ammonium chloride. Both these processes are still used today.

As time went on, metallurgists began to realize that this metal consisted of an entire family rather than just one element. They found it to be a group of six members: platinum, palladium, iridium, rhodium, osmium, and ruthenium. Though all these metals possess notable resistance to corrosion and high melting points, they differ in structure and various other properties. All are white in color, resist tarnish and other types of corrosion. Platinum itself is readily workable, melting only at the high temperature of 3223 degrees, Fahrenheit. Taken as a group, the platinum family has proved itself versatile and invaluable to the varying needs of our complex civilization.



Platinum alloys are of enormous importance to chemists. Here platinum electrodes are used in testing

We have come to take electricity for granted. Yet without platinum this important possession of civilization might not have been put to such wide use. The development of electrical contacts, standard resistors, and primary battery electrodes was greatly assisted by platinum and, in some cases, made possible only by it and its sister metal palladium. In these uses platinum was valuable because of its high resistance to spark erosion, its staple thermo-electric behavior, and its excellent machining characteristics.

The use of platinum lead-ins in Edison's carbon-filament lamps created a tremendous demand for the metal eased only by the development of platinum-clad and later, copper-clad, nickel-iron lead-ins. But for platinum, the invention of the incandescent lamp, the X-ray tube, and certain equipment necessary for radio broadcasting would have been delayed several decades and the electrical art might still be in its infancy.

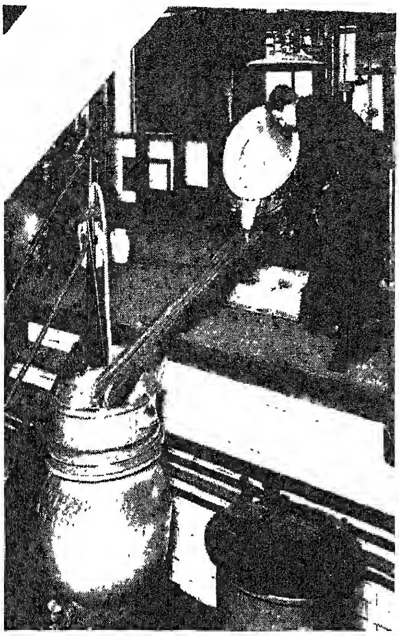
Every time we make a long distance telephone call, platinum and palladium are put into service as contact points along the line. They assure a clear connection. These two sister metals are employed in telephony and radio wherever longevity and infallibility of service are requisite.

A WIDE variety of relays, thermostats, and electrical measuring instruments employ platinum to insure low resistance and constant contact for reliable operation. A new use for the metal in this field is for fuses to protect sensitive instruments from overloads. These fuses are made of an iridium-platinum wire drawn to a practically invisible fineness. They can be designed to blow out with a current of a few milliamperes, functioning so rapidly that the instrument they protect cannot be damaged by overloading. Because of resistance to corrosion, similar wire is used for detonating caps.

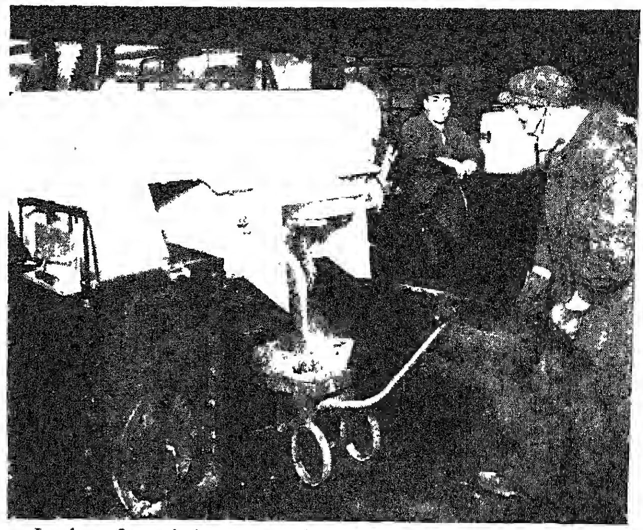
High and maintained reflectivity is another important property of the platinum metals. The United States military forces rely on this property when they use rhodium to surface the great all-metal reflectors in the 60-inch searchlights which are maintained for coast defense. A new use in this field is for the rhodium-plated, all-metal reflectors which are being substituted for glass reflectors in moving-picture projectors.

When gas and gasoline engines were invented, platinum was again summoned: first for hot-tube ignitors, later for the contacts in make-and-break ignitors, and even later still for the contacts in high-tension spark coils and magnetos. The

*World's largest producer of the platinum metals.

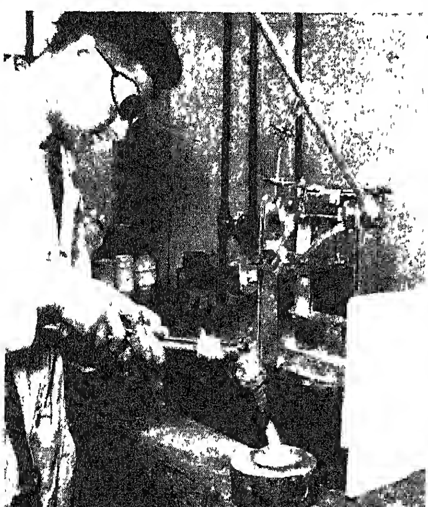


Platinum solution being poured from the dissolver via trough into the filter top



In the refinery it is necessary for workers to wear masks against poison gases as platinum solution is poured from concentrate solution

*Above:* Casting an alloy melted by induction. Temperature is determined by optical pyrometer



*Above:* Remelting platinum in a crucible with a hand torch prior to casting it in a delicate mold

*Below:* Forging a bar of palladium in a precious metals refinery with a heavy drop forge

*Below:* No delicate jewelers' tools here—heavy machinery rolling out platinum sheet into workable strips

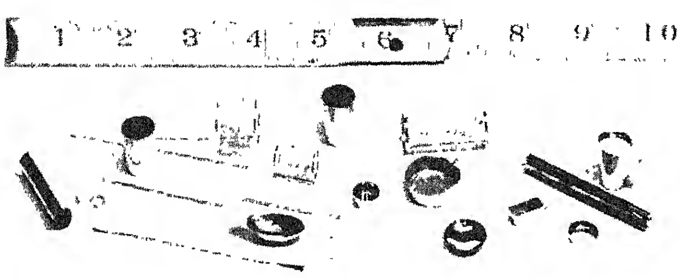
advent of single-spark battery ignition permitted the use of tungsten for contacts, but in aircraft and other high-tension magnetos, where reliability is a primary requirement, platinum alloys are currently employed.

It is in reducing the cost of fertilizer that platinum has become one of the farmer's best friends. In this instance, the ability of the platinum metals to promote, or catalyze, various reactions between chemicals makes possible the synthetic production of nitric acid from ammonia. This application uses a rhodium-platinum alloy in the form of very fine gauze. Besides being valuable as a fertilizer base, nitric acid is vital to other industries—to the manufacture of explosives used in mining and construction, for example. A large portion of the world's sulfuric acid is produced with platinum catalysts.

Most reactions of importance in metallurgy, glass technology, and many other fields proceed best, and often only, at high temperatures. The study of such reactions requires a material to hold the substance being investigated and a means for securing and maintaining the requisite temperature and for measuring the temperature. As it turns out, the platinum metals, because of high resistance to corrosion, resistance to oxidation, and high strength at elevated temperatures, coupled with resistance to molten oxides and silicates, are generally the most suitable for performing these functions. In this field of research, a recent development has been the making of miniature laboratory equipment for micro-analysis.

IT is in the recent vast improvement in rayon that platinum and its alloys have played so vital a part. Manufacture of the fiber requires thousands of spinnerets—small cups pierced with a multitude of hair-fine and often invisible holes through which the cellulose solution is forced to make the tiny threads. The minute holes in these spinnerets must be so fine and of so precise a uniformity that platinum is the one metal having sufficiently high mechanical properties and good machining characteristics for this application. Furthermore, platinum is not affected by the strong acid solutions used in cleaning the spinnerets which must be kept entirely free from plugging to permit easy flow of the cellulose solution.

There is great excitement in the glass industry today and several innovations have already come out of it in which platinum is playing a vital part. One of these, the manufacture of glass fiber, employs platinum for the jets or nozzles through which the molten glass is forced. There is nothing new about glass fiber for German manufacturers have been making glass fiber since before 1878 but their product has been a coarse, impure, imperfect one, the result of a slow, expensive process. By means of the new process which owes a large measure of its success to this use of the platinum alloys, it is possible to produce perfect fibers of varying lengths and thicknesses.



Micro chemists, analyzing minute samples, use solid platinum crucibles, pans, wires, and so on, so small that a set of 26 items weighs less than 60 grams

It was only at the beginning of the present century that the use of platinum in jewelry, its best known application, became at all widespread. Since 1906 the jewelry industry has been the largest purchaser of platinum. Diamonds look much whiter and are held more securely when mounted in platinum. The excellent strength and high ductility of platinum alloys have also made possible the production of fine wire and minute stampings, thus revolutionizing jewelry design and resulting in a lighter, more graceful, and more delicate construction than was possible with gold. The State Crown of the Queen of England, which Queen Elizabeth wore at the coronation ceremony on May 12, was mounted entirely in platinum.

Less histrionic but just as important in its own way is the part that platinum and palladium play in the daily drama of the dentist's chair, for dentistry is another field in which these two have now become invaluable. In the medical field, platinum and platinum-iridium are used for radium containers—needles, cells, and tubes for the treatment of cancer. In this use, platinum's density, making possible the filtering of certain unwanted radium rays, and its excellent machining properties, allow the fabrication of containers of more minute size than is possible with other metals.

It would be futile to attempt to describe the multitude of other applications in which the platinum family has become useful. Platinum is used for fine medals, trophies, and cups for which a metal with a high degree of plasticity is required to reproduce the high relief and fine detail cut into the die. Palladium has been developed in leaf form for decorating fine books and art objects as well as for interior decoration. Rhodium, widely used for plating silver in order to protect it from tarnish, is finding a new use in road signs which reflect a warning at night under automobile headlights. Platinum can be drawn into wire as fine as 50 millionths of an inch in diameter. This property of the precious metal was recently employed in a laboratory for clinical pathology when platinum-iridium wire was used for measuring the degree of nervous tension in human beings. By means of this development, a delicate instrument, fitted with wires so fine that they can be inserted into a muscle or nerve without causing pain, reduces the "jitters" to terms of electric voltage.

THE principal source of supply of the world's platinum metals is in the copper and nickel ores of Canada. These precious metals, with gold and silver, are recovered as by-products of the nickel and copper in sludges or precipitates at the bottoms of the refining tanks. The sludges are then shipped to the precious metal refinery in England to undergo an initial smelting operation in which lead is used as a collector of the precious metals. Subsequent cupellation removes the lead and a silver-rich precious metal alloy remains. This alloy is then parted with sulfuric acid after which an aqua regia treatment dissolves most of the platinum, palladium, and gold. Platinum is then precipitated as platinic-chloride which, on ignition, yields pure platinum sponge. Palladium is precipitated as palladosamine chloride, yielding palladium sponge. The silver and gold are purified by electrolysis. The final insolubles and reduction residues are re-melted to concentrate the rhodium, ruthenium, and iridium which are later separated.

Platinum is not only produced by processes little short of alchemy, but it is being put to work by modern industry in processes which are equally startling. The traditional distinction between commercially pure and chemically pure products is disappearing in one industrial process after another, and in this progress towards purity platinum is providing the material out of which is made equipment which otherwise would contaminate the product. Herein lies the growing importance of the metal's contribution to industry and of industry's contribution to an expanding use of platinum.

# SPEED AWING

## Traditional Speeds of Birds are Often Greatly Exaggerated . . . Determining Flight Speeds with a Stop-watch . . . The Plover Makes a Falcon Look Silly

By S. F. AARON

Drawings by the author

IT is high time to correct some of the traditional assertions respecting the flying speeds of birds; this article has been written only after careful and continued observations. Nothing is more oppoitune for conjecture, nor offers wider chance for miscalculation, than bird speed. Some of our very best and most reliable bird books, and many oft-quoted statements by writers of scientific acumen, indulge the very common and eagerly received notions of flying speeds that are proverbially exaggerated. Audubon, by no means always accurate, yielded to the same tendency.

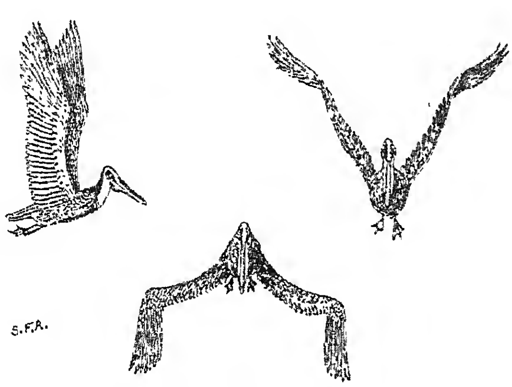
Quite commonly the 100 miles an hour rate is claimed for a number of species, from the frigate-bird to the hummingbird, and from the swallow and the swift to the swan. The falcons also share in these exaggerations.

Now, it is very possible that the great sea pirate called the man-o'-war bird, with the aid of a high wind and after a long-continued momentum in one direction, can attain a very high velocity; but that the creature can eat breakfast in New York and take a late dinner in London, as has been claimed, is altogether absurd.

It cannot be denied that the chimney-birds, with any members of the true swallow family, seem to excel in wing speed almost any other species, and that they *may* at times reach a rate that would, if recorded, clip many seconds off what they usually attain. That wild ducks, geese, swans, terns, hawks or falcons—the great company of waders or sea birds—can attain speeds of more than 60 miles an hour for short or long distances is very decidedly doubtful and the accurate study which follows discloses this fact.

ACCURATELY determining the average flight of birds over measured distances with a stop-watch is less difficult than merely painstaking. It demands more patience than brains, and it affords much pleasure and satisfaction. Selecting the season counts largely. The method employed was by no means original.

With a companion who knew less about birds than he did of surveying, but whose still youthful interest in any subject related to his own work stirred his enthusiasm, a test was made of the flying speed of several species. The selection of the place for the experiment was fortunate, and the season was that of the spring migrations of birds toward the north, when those species that left southern localities were in an evident



Brown pelicans. In the lower figure the downward stroke is at its limit and the lift about to begin. Drawn from memory

hurry and those that remained to nest nearby were restless, mating and trading about.

By triangulation the distance between two points on the bluff-bordered Corpus Christi Bay, some five or six miles below the city of Corpus Christi on the southern Texas coast was found to be just one third mile, and to extend nearly north and south. This course faced a wide expanse of the bay, with a shallow beach upon which many birds came to spend the winter and from which they started to their far northern nesting places.

Out from the short, straight line of measured coast an unfortunate coastal sloop had foundered; its rotting mast stump was at direct right angles to the course from the position where my fellow investigator took his stand. He had a shotgun, the shells especially loaded only with black powder so that the smoke of the discharge could be seen.

From my position on the top of the long bluff I could watch an area of about 90 degrees from the shore line between us. There we waited not five minutes before a reddish egret winged its way past my collaborator and headed toward my position.

As the bird crossed the line between the bluff and the old wreck I saw the smoke belch forth from the gun, the noise hurrying the bird—as we had intended. On the instant I pressed the release of my stop-watch. When the heron came opposite my stand, I again pressed the stop-watch and noted the elapsed time—one minute, one second—or at the rate of a little less than 20 miles per hour.

This was an auspicious beginning, but what followed was more like missing a train at a one-track way station without a time table. What would come next and, if ever, when? Had the world suddenly become bereft of birds? Was that egret the last representative of a vanishing class? Not quite, for—how long afterward I do not know—I was stirred from something bordering a dream by the distant boom of that gun and again I pressed my stop-watch. This time it was another egret of the same species, but snow-white—the young of the first or second year.

On came that spot of white with regular beat of wings and the watch showed one minute, four seconds: perhaps about two additional seconds had elapsed between the actual firing of the gun and my finger action. The near coincidence in flight time was not at all remarkable, for once we had watched two of these birds winging their parallel way across the water and they kept truly together for the full half a mile that we could note them.

And then we had occasion to be alert, for soon there followed several brown pelicans. These also kept pretty well together; for exactness, the leader was selected and timed. These brown pelicans fell behind the record of the egrets by only four seconds. Perhaps the report

of the gun had not hurried those big-billed, homely specimens at all. Almost immediately afterward, however, the report did hasten a bunch of four mallards—three emerald-headed drakes and one hen. They veered out a little, not flying exactly parallel to the coast, making the distance traversed a little longer, so I snapped the watch about two seconds before they came opposite my stand and the time was 46 seconds—not nearly as fast as the swiftest horse could cover the same space and only a little better than 26 miles an hour, even allowing for possible errors.

Next came two egrets that turned in, however, and alighted about half way on the beach; a flock of bald-pates that turned out and flew wide of my stand; several Caspian terns that indulged in erratic flight, after their manner; a number of birds that turned south instead of north, or flew crosswise from the land. Then, after another long wait, came the hoped-for opportunity of timing a black skimmer, one of a group of three.

THIS swallow-like fellow, in ease and seeming rapidity of flight, did not make the distance straight-away, but approached at an angle after making a wide turn, and afterward we had to calculate the distance it covered. We were greatly disappointed, the elapsed time being 47 seconds; for, with the turn, this was just a little slower than the mallards. Nevertheless, we were firmly of the opinion that these wonderful birds can, if need be, pretty nearly challenge the world of wings. We may have made an error in that angle, or the group of skimmers that kept well bunched were not doing their level best, as they are not hunted and do not fear a gun.

A long wait followed, with many birds going both ways, but none straight nor parallel, nor making the full distance. Finally we signaled to quit for the day.

On the following morning we again took up our positions, without a single satisfactory result, for four long hours.

On the third day, with a so-called "norther" blowing—which means a cold, foggy spell—we decided not to attempt the test, but gazing out to sea we discovered myriads of birds on the wing, low and passing overhead, flying across a stout wind. It is indeed difficult to account for the whims of migrants. Thereupon, right gladly, we regained our positions and soon observed a flock of seven or eight black ducks skirting the coast northward, apparently bent upon getting somewhere quickly. Their time was 40 seconds, and their speed therefore was at the rate of 30 miles an hour—a little faster than the mallards of a few days before, but the wind may have somewhat aided the blacks.

Again, after a long wait and several failures, a half dozen bald-pates negotiated the straight line of coast at a rate corresponding to that of the mallards, and very shortly afterward we were delighted when four blue-winged teals gave us an equally fine test. There were two drakes and two hens, probably long mated, and they were in the usual hurry that all the teals seem constantly to practice. Again we were disappointed, for these small ducks always had appeared to us the speediest of their family, and I believe they have commonly received that distinction. Their time was only 38 seconds, or 31½ miles an hour—by no means phenomenal and far below the reputed 100 miles an hour.

Cooper's hawk. Wing stroke is 105 degrees and the number of strokes nine per second at best speed

This job was a long and delightfully tiresome one, full of disappointments, but fascinating for a time. In the further seven half-day trials that we made in the next ten days we obtained the speed of one golden-eye duck, which equaled that of the teal; one south-southerly (duck) that, allowing for possible error due to a swerve, probably bettered the teal by a fraction; a small company of gadwalls that fell slightly behind the 26-mile mallards; a glossy ibis that did not do quite as well as the egrets; and two willets that considerably exceeded all the rest while making, we believed, a fair average speed of their kind. I think these last were in a big hurry, for their time was only 33 seconds—a trifle more than 36 miles an hour.

I have always, following other observations (though these may have been of a less careful nature) believed the snipe, plover, and shore bird species to be, with very minor exceptions, among the swiftest of all birds awing, and here was partial proof of this notion. I suspect it will have to be admitted that they are in the 50-miles-an-hour class, with doves and homing pigeons if these are hurried, and probably the flycatchers and warblers during migrations.

ONE possible weak point in these tests consists of the certainty that all birds commonly fly with the least possible effort and that, when necessary, they can and do improve their speeds [though the velocities claimed by tradition apparently are not based on the speeds at which birds can fly, but those at which they do fly. For example, "Wild ducks fly at 100 miles an hour." —farmers' almanacs (compiled, by the way, in city offices).—*Ed.*]. But I think the birds which we observed on the Texas coast indicated that they were at least in somewhat of a hurry. Another fault is that so few representative tests were made.

The speeds of waterfowl have been tested by airplanes. One statement makes the heavy, comparatively slow canvas-back duck fly faster than the pin-tail, which is generally considered swift; it also gives the canvas-back a speed 25 percent faster than the mallards, which is altogether absurd.

Automobiles, the speedometers of which are quite accurate, meet the need of even more convincing tests of bird flights, if by rather rare chance while touring country highways birds will fly parallel with the road, even for short distances. Some few such tests that were made agreed with those made on the Texas coast and complement them. With the car going at about 20 miles an hour along a creek road, a little green heron kept with it for a short distance, and I doubt whether it could have improved its speed. Traveling parallel to a wide slough at about the same rate permitted two wild ducks of a species not ascertained, because they were beyond a line of trees and 50 yards away, easily to exceed the speed of the car.

On a road at over 40 miles an hour we kept right along with a lone duck,

probably a black duck, flying overhead. A driving speed of 30 miles an hour between meadows in southern New Jersey permitted a kildeer plover to draw ahead of the car, and only at a 45-mile speed could the bird's rate be equaled. The kildeer is built like the willet and probably few birds can fly faster. At this same place and speed a spotted sandpiper, springing from a ditch beside the road, kept easily with the car for several yards before veering off.

At a 30-mile speed, sparrows, bluebirds, meadowlarks, and robins are passed. Flickers and red-headed woodpeckers can barely keep up with a 25-mile rate. Once, going at 35, a sparrow hawk, while making an effort to surprise a flock of domestic sparrows dusting in the road far ahead, raced the car. The falcon kept about 40 or 50 feet in front of us, dashed over a hedge, seized a sparrow and went on. An acceleration to 40 miles an hour caused a slow gain on the bird of prey until it turned suddenly off. This is the most complete test I have made.

GOING at a 50-mile speed keeps pace for a few yards with chimney swifts skimming rapidly over fields and with barn swallows passing back and forth across the road and low beside the car. But such tests are somewhat uncertain because of erratic flights and the short distances in which the birds, often frightened, really race with the car.

The speed of certain birds of prey is greatly exaggerated. I have seen across a narrow mountain valley a ruffed grouse keeping well ahead of a pursuing goshawk until a thicket of laurel was reached into which the grouse dived safely. In exactly the same manner I have seen a bobwhite hold its own against a sharp-shinned hawk until bob dropped into some briars.

I once saw a duck hawk stoop from a very short distance overhead that gave it little momentum and dash at a running plover. The plover started from scratch and with comparatively great speed made that falcon, the boasted "speed king of the air" (of the nature fakirs) look silly. It is only when falcons dive from a great height that they attain tremendous velocity. But I have twice observed duck hawks stoop at ducks and fail to strike; the bird of prey did not follow when the intended victim made off at right angles to the hawk's direction. In one instance the missed meal was a black duck, in another a green-winged teal. I have also seen the duck hawk employ the same method in an attempt to punish a crow that, a few minutes before, with several companions, had harassed the hawk. Failing at this, the hawk tried to overtake the crow in a straight-away, but again failed. I believe the hawk knew in each case that the chase would be futile. Contrary to common impression, the crow is by no means slow; it commonly overtakes the buzzard hawks in the air, and even the kingbird has to speed up to overtake a crow. [It seems quite probable that some birds which fly with rapid wing strokes may thereby create a misleading impression of speed, while some with deliberate strokes may thus give the impression of low velocity. Possibly this has even been the largest factor involved in the traditional mis-estimation of bird speeds.—*Ed.*]

As does the puma, hawks generally depend upon a swift dash from behind, that is not at once observed by the intended victim which is often pursuing its deliberate way within a flock of its fellows. Domestic pigeons are sometimes captured in this manner. I am convinced that it is safe to say that in a straight-away flight no hawk is swifter, nor indeed as swift, as the mourning-dove, nor any of the snipe and sandpiper family. This statement is derived from numerous personal observations.

When Professor Fisher found the remains of chimney-swifts, juncos, warblers, and doves in the stomachs of falcons it can be safely asserted that the victims were either young or injured birds. I have seen a sharp-shinned hawk—and I would wager it was an inexperienced young one—dive to intercept a barn swallow and be avoided with the greatest ease.

But if we wish to seek for the swiftest of all birds, I beg that the hummingbirds be considered. It is but necessary to note their straight-away dart across a sunlit meadow as far as the tiny creature may be seen for this opinion to be held.

I THINK that rapidity of wing stroke, combined with the length of the stroke, commonly determines speed. A variation in individuals may be observed, as with the kingbird and the meadowlark. The average stroke of such larger, slower birds as the herons, pelicans, spoonbills, gulls, ibises, and the buzzard hawks, as far as can be ascertained from many dim photographs, is between 70 and 80 degrees, and the strokes may vary in number from three to four per second—perhaps four or five in crows which, because of their better speed, are alone an exception to this rule.

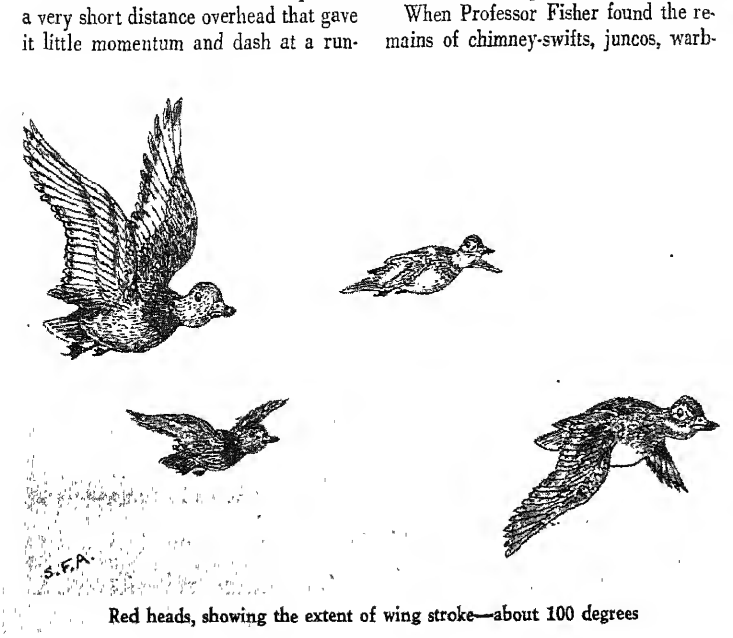
With the faster ducks, geese, and swans the wing stroke is at least 100 degrees and more rapid than five or six per second. In the true swallows the strokes are slow, as compared with most other small birds, but consist of very great and powerful sweeps apparently all of 150 degrees in vertical extent. With the shore birds and plovers, all apparently much alike, the rate of the strokes is not countable, but they cover at least 120 degrees, often greater.

Yes, bird flight speed has perhaps been exaggerated; further study of the subject is indeed indicated.

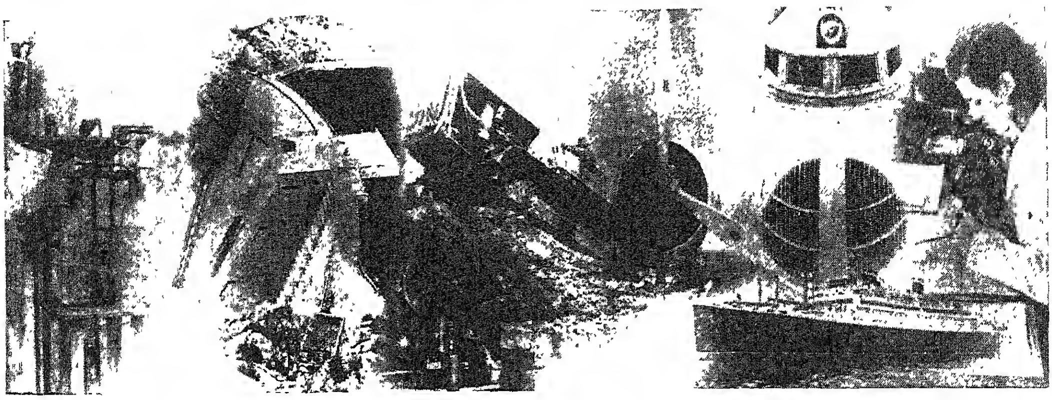
●

*As so aptly put forth in "Flight Speed of Birds," Circular Number 428, United States Department of Agriculture, the often over-estimated speeds of game birds in particular may be at least partly laid at the door of the gunner who, to assuage his wounded vanity, estimates that the bird he missed must have been flying at a speed "of 100 or even 150 miles an hour."*

*Readers who desire to pursue farther the absorbing subject of the speed at which birds fly, having had their appetites whetted by the foregoing article, will do well to obtain a copy of the above mentioned circular, procurable from the Superintendent of Documents, Washington, D. C., for five cents in coin. Here they will find a careful compilation of data obtained from various sources, some details of the methods of measuring bird speed, and a tabulation of speeds of various birds. The complete bibliography included will be invaluable to the nature student.*—The Editor.




**Red heads, showing the extent of wing stroke—about 100 degrees**



# THE SCIENTIFIC AMERICAN DIGEST

Conducted by F. D. McHUGH

Contributing Editors

ALEXANDER KLEMIN
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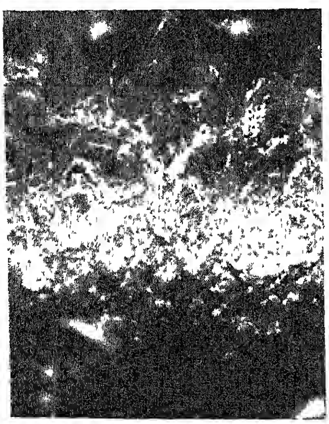
D. H. KILLEFFER
Chemical Engineer

## How Hot is Hot Enough?

THE surprising answer to this question is confirmed by the two accompanying, high-speed photographs of ethyl acetate boiling at atmospheric pressure. When a drop of water falls on a red-hot stove and skims merrily over the surface instead of bursting immediately into vapor, it is danc-



ing on an insulating film of steam. If the stove were cooler, the insulation would be less, the vaporization quicker.

Researchers in the Department of Chemical Engineering of Massachusetts Institute of Technology have shown that the same principle applies to the heating of liquids by hot pipes immersed in them; if the pipes are too hot, the heating of the liquid will be less efficient because vapor films form around the pipes, which retard the heat

In the upper picture the steam-heated aluminum tube is 73 degrees Fahrenheit hotter than the surrounding ethyl acetate, and the heat transfer rate is 41,000 B.t.u. per hour per square foot. In the lower picture the temperature difference is much greater—104 degrees Fahrenheit—but the heat transfer rate is much lower: 5800 B.t.u. The reason is visually apparent: The hotter tube below is coated with an insulating film of vapor. The researchers at Technology, working under the direction of Professor W. H. McAdams, '17, have found that the temperature difference at which maximum rate of boiling occurs is small for many liquids.

An understanding of such principles of heat exchange is important to many industries that employ boiling of liquids—in the separation, for example, of petroleum products by fractional distillation, in the concentration of acids by evaporation, or even in the quenching or tempering of metals by plunging them at red heat into a bath of water or oil.

This data supplied by E. T. Sauer, and the photographs (exposure 1/100,000th second) by W. B. Tucker—used by courtesy of *The Technology Review.*

**CHROMIUM**

**THE metal chromium gives to the emerald its rich green color, to the ruby its red, and to the sapphire its blue.**

## Vitamin A and Dim Vision

IN the retina of the eye there is a substance called visual purple, which is bleached by the light coming from objects at which we look, but is constantly being regenerated. Recently it has been discovered that this regeneration is derived from vitamin A. Persons who are short on vitamin A

so they see poorly in a dim light. Many of these are motorists whose dim vision has puzzled them. Now comes an instrument for measuring vitamin-A deficiency by means of visual purple. According to the Frober-Faybor Company, Cleveland, manufacturers of scientific instruments, the bio-photometer test for vitamin-A deficiency is based on the well known fact that the reserves of vitamin A in the body influence the rate of regeneration of visual purple. Upon exposure to bright light, visual purple is bleached more rapidly than it is regenerated, accompanied by reduced light threshold. When the eyes are rested in the dark, regeneration of visual purple takes place, the light threshold reaching an optimum level dependent upon the reserves of vitamin A available. Characteristic differences in the rate and extent of regeneration of visual purple in subjects more or less vitamin-A deficient give a clinical test for even mild and progressively more severe vitamin-A deficiency.

In its simplest essentials the bio-photometer test is made as follows: At the beginning of the test, the visual threshold of the patient is determined in millifoot candles with the bio-photometer. Next the patient rests the eyes in the dark for a standardized period of time. These readings are for the purpose of minimizing variables in environmental lighting prior to the test and to familiarize the patient with the procedure of the test and the appear-

ance of the variably illuminated test spots.

Next the eyes are exposed to a bleaching light of standard intensity for a standard length of time. Then the bleach light is shut off and a series of readings is made which indicates the rate and extent of regeneration of visual purple.

Since the rate of regeneration of visual purple is influenced by the availability of vitamin A in the system, it follows that ingestion of vitamin A should result in improvement in the rate of regeneration of visual purple. Such is the observed fact. The ingestion of supplementary vitamin A is followed by improvement in rate of regeneration of visual purple until a level is reached which may be taken as the optimum for the subject.

### PEARLS

FOSSIL oyster shells in three collections in Germany have been found to contain three embedded pearls. As the age of the shells is estimated at 150 million years the pearls are probably the oldest in existence in the world.

## Rotary Compressor for Air Conditioning

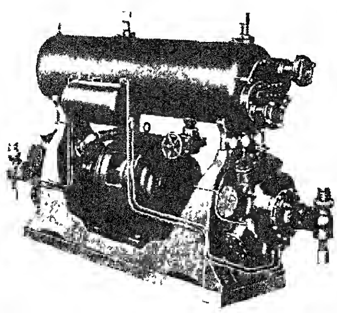
A MAJOR engineering achievement that holds promise of greatly improving air-conditioning practice was announced recently in New York City. The new development is a complete line of high-speed compressors that turn up 1750 revolutions per minute, utilizing for the first time the radial principle of design—cylinders placed in a circle around the crankshaft. The new development was made by Airtemp, Inc., air-conditioning subsidiary of Chrysler Corporation.

The new units incorporate the same principle of design as that adopted by aeronautical engineers to eliminate motor failure in airplanes and to increase the motor capacity in proportion to weight. Exhaustive tests and months of performance under all sorts of operating conditions—in actual commercial air-conditioning installations—confirm the advantages of the new compressor, it was stated.

"The compressor is the heart of any air-conditioning system," it was pointed out by Colonel A. C. Downey, President of Airtemp, who discussed his company's new development. "Upon the efficiency of the compressor depends the efficiency of the entire air-conditioning system.

"These new radial type compressors, which are built in sizes from 10 to 75 horsepower capacity for commercial installation, possess many practical operating advantages. In the first place, they are far more dependable."

The new radial compressors greatly simplify problems of commercial air-conditioning installation because they are light in weight, compact in size, and entirely free from vibration. They can be installed in practically any part of a building, according to C. R. Neeson, Airtemp's Chief Engineer, who directed their development.



"These radial compressors require no special foundations," Mr. Neeson stated. "The ordinary air-conditioning compressor for commercial installation—due to its weight and vibration characteristics—has to be placed in the basement of a building, on a specially constructed foundation. Basement space is valuable, and Airtemp radial compressors are designed for space-saving installation. Another important engineering feature of the new radial compressor is its perfect dynamic balance.

"Another feature of these compressors which contributes to more efficient operation is the use of auxiliary intake ports at the bottom of each cylinder. These ports are opened by the piston itself, as it completes the downward stroke. The use of the auxiliary ports accelerates intake and thus increases efficiency."

*Above:* A close-up of the rotary air compressor, and, *left,* the compressor assembled with the other parts of an air-conditioning installation

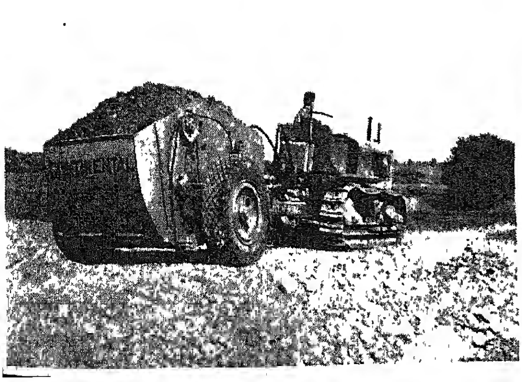
## Meringue from Soy Beans

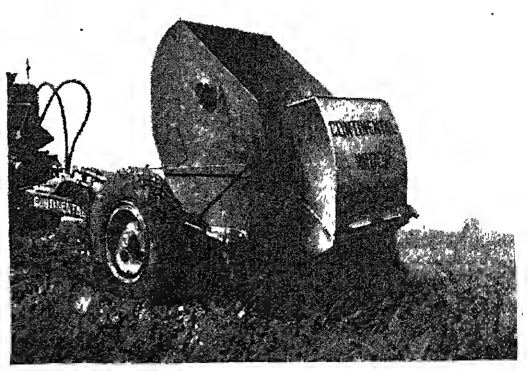
WHEN soy-bean flour which has been completely freed of oil by solvent extraction is dissolved in water, the resulting solution can be whipped into a stiff white foam greatly resembling egg white. Since protein in the form of soy meal costs only about 1/10 as much as protein in the form of eggs or milk, which it resembles dietetically, research has been directed toward its use to replace these more expensive foods. The whipping quality of soy meal is destroyed by the presence of fats and by the treatments used in the past to eliminate its raw bean flavor. Complete removal of the fat or oil by ethyl ether or petroleum ether and deflavoring by heating in a vacuum to 130 degress, Centigrade, leaves the meal with a high whipping characteristic. Advantages of the extracted soy meal over egg white are its cheapness, its keeping qualities, its ease of standardization, and its high concentration as compared with egg white, so that it may be whipped with many liquids. Its use is suggested in frozen desserts made in the electric refrigerator, with gelatin and cooked starch in whips, sponges, and molded desserts, and with cooked sugar in confectionery. Replacing egg white in baked dishes which depend upon the ease of coagulation of egg protein seems yet doubtful until new methods for using the soy protein are developed.—*D. H. K.*

## New Four-Yard Scraper

A NEW four-yard wagon scraper known as the "Junior Continental" has been announced by the Continental Roll & Steel Foundry Company. Designed for use with smaller 35 to 50 horsepower crawler tractors, the new four-yard model is the same in general design and operation as the larger Continental models.

The manufacturers claim that their new four-yard wagon scraper is light in weight without sacrificing the ruggedness necessary to dig, load, and haul capacity loads of





tough clay, rock and tree root imbedded soil, shale, hardpan, and so on.

Other features of this Junior Continental are high axle clearance, a large fast-dumping rear gate, the new Continental BE-GE hydraulic power-control unit with adaptors for all tractors of 35 to 50 horsepower, shorter overall length for easier turning, and a wide cutting blade, the width of cut being the same as that of the five-yard size

## Resins for Water Softening

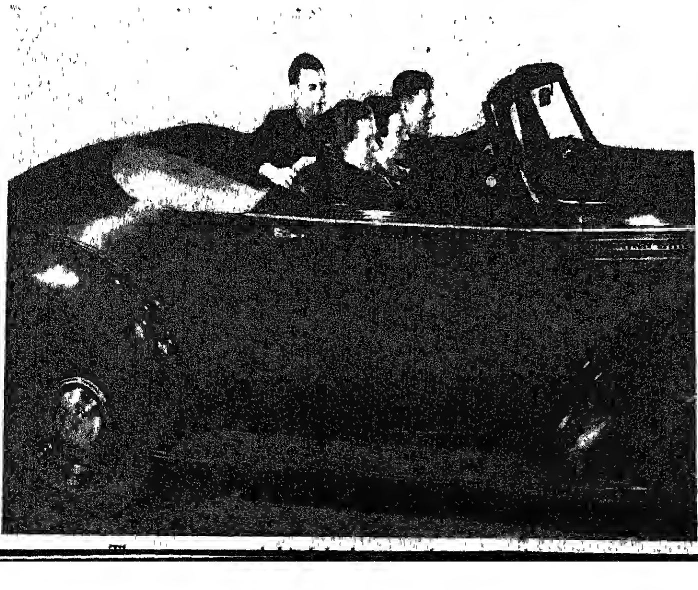
SYNTHETIC resinoids having the property of exchanging sodium for calcium and magnesium in water are being increasingly used for softening hard water in Great Britain. The resinoids are made by the reaction of phenols of the tannin group with an excess of formaldehyde. When these resinoids are placed in water containing lime and magnesia they combine chemically with these elements, thus softening the water. The resin is regenerated by passing a strong solution of salt over it. Tannin resinoids leave the water acid in character and to offset this a second treatment with a basic resin made by condensing polyamines with formaldehyde is applied. This water-softening property of resinoids is similar to that of the mineral zeolite used in the United States for a similar purpose. —*D. H. K.*

**ELECTRICITY**

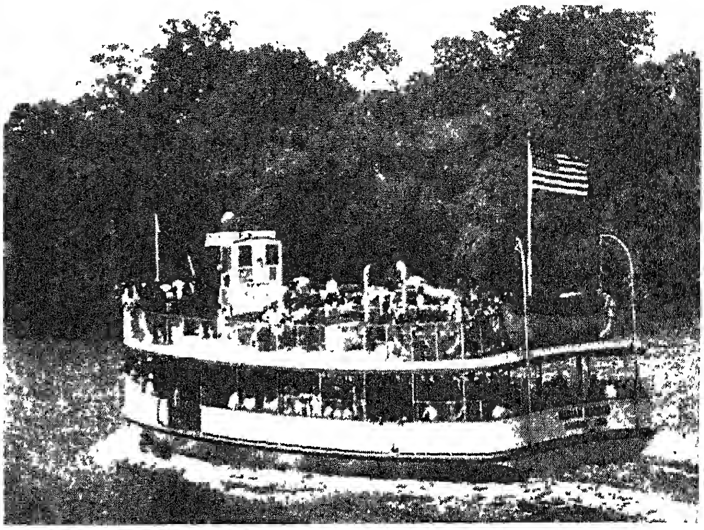
**AIR passengers may, in the future, find that they can use on airplanes standard household electrical appliances. This is in line with the prediction that airplanes will be equipped with 110-volt service soon.**

## Transverse Seat

THE transverse extra seat as used in several models of the Hudson line of motor cars is reported to be proving very popular. Introduction of the extra seat behind the regular front seat does not cut down the baggage space at this point, for when the seat is unoccupied there is room for large parcels and even a couple of suitcases or golf bags. All in all the seat is a success from every standpoint and the passenger who rides in it is really "one of the party."



# TRANSPORTATION SECTION



Fire-proof and safe is this new all-steel ferry

## 65 Foot Greenwich Ferry Boat

THE Town of Greenwich, Connecticut, is the fortunate owner of Little Captains Island, a wooded sand bar about two miles off the Greenwich shore in the open waters of Long Island Sound. The town has a municipal park on this island, with numerous bath houses, restaurants, and other concessions that go to make up the success of such a recreation spot.

From 2000 or 3000 people visit the island daily during the pleasant summer weather and it is quite a problem to transfer these people from the mainland to the island and back again with safety and dispatch, yet at reasonable cost. For many years the town used a 65-foot wooden ferry boat but the demands of the service have become so great that last winter town officials advertised for competitive plans and designs for a boat not over 65 feet in length to meet the growing needs of this traffic. The result of the competition was that the Luders Marine Construction Company, of Stamford, built a unique craft, quite different from the orthodox type of ferry boat. The principal feature, of course, was safety and the designers elected to offer an all-steel vessel of arc-welded construction, 65 feet long, 26 feet beam over the guards, 5 feet draft, and subdivided into 10 watertight non-communicating compartments to insure the last degree of safety.

The contour of the boat is like that of a blunt sadiron, the bow circular and the stern almost square. With the numerous subdivisions in the hull, it is almost inconceivable that grounding or collision could damage the boat to the extent that would prevent her from making shore in safety.

To eliminate the fire hazard, it was decided to make the boat Diesel-propelled, and a twin-screw installation of Superior Diesel engines is used, each engine developing about 45 horsepower which gives the boat a speed of about 8½ knots. A reduction gear on the motors with a ratio of nearly 4 to 1 permits the use of large propellers so that backing and maneuvering is most positive. To improve the handling, the boat is equipped with two rudders which enable her to dock in the extremely small spaces available at the Greenwich end of the run.

This little boat with her unique design unquestionably marks a distinct step forward in the art of designing small passenger vessels. It has what is called a modified Vee bottom, on the shape and details of which the designers have applied for a patent. The model is not only an unusually seaworthy craft but is easily driven and lends itself to inexpensive construction.

## Parking Meters

THERE are approximately 14,300 parking meters now installed along the streets of 28 United States cities. While metered parking is new, the principles involved in decisions concerning its legality

benefit to abutting property is in the provision of access, light, and air. The other use is for movement of people and vehicles, water, light and other utilities. Parking, therefore, or the right of access, must be so regulated that other rights are not infringed upon. Several decisions have been rendered in recent cases involving municipal ordinances which provide for the setting up of permanent meters at street curbs and the collection in this way of a small fee for the use of these spaces for limited parking privilege.

Cases in Oklahoma, Texas, and Florida involving claims of the motorist that parking meters create an illegal obstruction to traffic were overruled. In Alabama the owner of land abutting on such a parking space brought suit on the grounds that the right of access to his property from the street was obstructed, and the ordinance was held void. The Alabama Supreme Court outlawed parking meters on the grounds that they constitute "an unauthorized use of the taxing power." A thorough study by the justices of the Massachusetts Supreme Court, however, has resulted in the opinion that a parking meter statute properly worded would be valid, and valid ordinances might well be passed under it. This opinion is expected to be of influence in other states.

To date legal opinion indicates that parking meter ordinances are reasonable if properly drawn: the spaces allotted must be suited to the streets, the traffic, and the needs of the abutter, and the charge must be no more than sufficient for the purpose of regulation; it cannot be imposed as a source of general revenue.—*Highway Research Abstracts.*

### FUTURE CARS

**THERE will be just as many improvements made on automobiles in the future as there have been in the past, Charles F. Kettering believes. These improvements must come slowly, however, for, he says, "if we knew what the car of 10 or 25 years ahead was going to look like, I believe we would be making it now."**

## AUTOMATIC INSPECTION MACHINE SEES, HEARS, FEELS

A TIRELESS automatic machine, which "sees" better than a hawk, "hears" better than a hare, and with a sense of "touch" infinitely acute, has been placed in operation at the Ford Rouge plant for inspection of the value push rods—small, accurately finished engine parts.

The uncanny device, which utilizes photoelectric cells and radio amplification to work its wonders, inspects valve push rods for hardness, hidden fissures, and accuracy of dimension. Ford V-8 standards demand precision to one ten-thousandth of an inch. The machine performs 11 distinct operations so rapidly that 42 push rods are inspected each minute. Those which do not meet rigid specifications are rejected.

First the push rods are checked for hardness. An automatic scleroscope works in connection with an "electric eye." A dia-

If the hardness is correct, the weight rebounds to a predetermined height, intercepts a light beam, and the electric eye actuates a mechanism which passes the push rod. Push rods that are not hard enough are rejected.

In the second operation, a hammer strikes the side of the valve push rod. By "listening" to the pitch and duration of the resulting sound, the machine determines instantly whether the push rod structure is without defect. A hidden fissure will curtail the period of sound vibration. A microphone and amplifier are part of the inspection mechanism at this test station.

Then follow nine other successive inspections to determine accuracy of manufacture. The first is for squareness of the bottom face of the push rod. Here the maximum variation permitted is one thousandth of an inch. Next the part is measured for roundness, with variation held within three ten-thousandths of an inch. Squareness of the top is gaged and, in this case, the limit is five ten-thousandths of an inch. Following this, automatic fingers enter the slots in the sides of the push rod to check for minimum wall thickness. Two steps gage the diameter, first at the center and then at both ends. These measurements must be within five ten-thousandths, the specified dimensions. In the final three stations, the parts are measured for length and sorted automatically into seven groups, with only one thousandth of an inch variation between groups. The seven groups are classified and stacked in boxes as follows: First group, undersize below allowable limit and are scrapped; second group, under standard size .002 of an inch; third group, under standard size .001 of an inch; fourth group, the standard or mean length; fifth group, over standard .001 of an inch; sixth group, over standard .002 of an inch; and the seventh group is over allowable limit and is reground. Approximately 85 percent or better run to the standard or mean length.

*(End of Transportation Section)*

## Insulin Saving Mental Cases

NOT many months ago, the mental disorder known as dementia præcox, responsible for a large share of the sick minds of the world, was a hopeless condition. Now, thanks to researches here and abroad, medicine seems on the verge of curing this ill in a large majority of the cases if they are caught early enough.

Insulin, the gland extract that makes life possible for thousands of persons suffering from diabetes, is the stuff that is rescuing other thousands from the living death of insanity. The total number of such cures is now well over 1000, and apparently is increasing every month, reports *Science Service*.

The new method of treating dementia præcox was discovered by Dr. Manfred Sakel of Vienna, Austria. It consists in giving large doses of insulin to produce a state of shock. In treating diabetes, small doses of insulin are given, and the physician is careful to avoid producing shock or coma, which may end fatally.

A fatal outcome is the chief danger of the insulin shock treatment for mental disease. Physicians and nurses stand by while the patient is undergoing treatment, ready to give sugar at just the right moment to

snatch the patient from death and back to sanity. The shock is allowed to continue from one to three hours, depending on the effects produced, and a series of insulin shocks are necessary to achieve the cure of the mental disease.

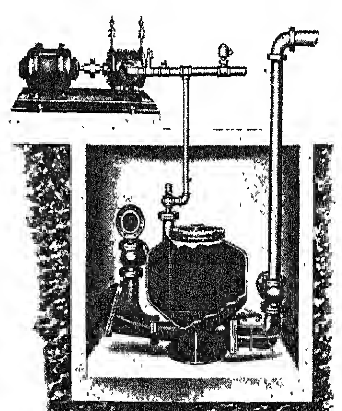
Why insulin shock restores sanity in some cases is not as yet definitely known. In diabetes, insulin saves lives by enabling the patient's body to burn sugar from food in a normal manner. In dementia præcox, Dr. Sakel believes the gland extract acts by isolating short circuits in the brain which are responsible for the mental disease. When scientists finally discover how insulin shock works to cure the mental disease, they will, it is hoped, have an explanation of what causes this mental ailment.

### INSECTS

**CERTAIN insects know the position of their limbs by tiny hairs on the leg joints which are bent as the insect moves. Human beings and other vertebrates "feel" the position of legs and arms by muscle position.**

## COMPRESSED AIR SEWAGE PUMPS

PNEUMATIC ejectors for pumping sewage or the sludge from manufacturing operations from low points into higher drainage canals or pipes are not new. The first such machine using compressed air as the lifting agent was built some 50 years ago by Sir Isaac Shone. In principle this is remarkably simple. Essentially such an ejector consists of a tank into which the sewage or sludge is poured; as its level



**Electrodes in the sewage tank operate a relay which starts a pump**

rises, metal bells rise and when the pot is filled these bells open a valve to admit compressed air. This pushes the sewage down and out of the pot, up the discharge pipe, and past special check valves which prevent it from flowing back into the inlet pipe.

A new pneumatic sewage ejector developed by Yeomans Brothers Company does away with all moving parts within the collecting tank. The design is basically the same as others that have been used for years except that two stationary electrodes set into the sewage tank control a relay which actuates an air valve allowing the proper air volume and pressure to enter the pot. All

moving parts have been removed from the pot. Such an arrangement obviates entirely the possibility of clogging; the device literally "works without works."

Modern cities, in addition to industrial plants, often have use for such equipment. The deep basements under all large buildings are practically always lower than the sewer mains and in such cases it is necessary to use pumps or ejectors of some kind to lift the sewage up into the mains whence it will flow by gravity to the sewage disposal plant.

## Life of Furnaces Aided By Steel-Jacketed Brick

METALLURGICAL furnace walls subjected to corrosive slags at temperatures as high as 3000 degrees, Fahrenheit, are said to gain added strength and service

One of the steel-jacketed bricks

life when constructed of an improved refractory brick known as H-W Improved Metalkase Brick. After being molded to accurate size under very heavy pressure each of these bricks is encased (on three sides) in a form-fitting jacket of mild steel.

In the furnace wall or lining, the bricks are laid as "headers," so that each brick is steel enclosed, except at the ends, to form a complete lattice of steel interlining the wall. At operating temperatures, the edges of the steel jackets adjacent to the heated face oxidize and melt, fusing with the brick itself to form a solid, highly-resistant interior surface. However, a short distance back from the heated face, the steel remains intact, adding greatly to the spalling resistance of the brick, and to the internal strength of the entire structure.

Formerly, the high temperature limits permissible and great resistance to corrosive slags obtainable with magnesite brick could not be freely utilized in many furnace applications, because of the limited physical strength of magnesite. The new brick is said to overcome this weakness, meeting "slag-line" conditions in open hearth and electric steel furnace walls, as well as the severe requirements of linings for cement and dolomite kilns, and the like.

## "Printing" Fabrics

FUTURE textile fabrics may be truly synthetic from the beginning, not simply made by the disintegration and reformation of fibers of plants, and the process of weaving itself may take second place as a method of making these synthetic fibers into useful clothing, according to Joseph F. X. Harold, writing in *Industrial and Engineering Chemistry*. Tomorrow's

clothing may even be made, from synthetic resins, by the aid of a process of photo-engraving which will avoid the tedious processes involved in present textile methods.

"Much is being done in developing fibers from synthetic resins that shall have the required strength and elasticity for enduring wear," Dr. Harold said. "It is highly probable that in the near future we shall have rayons that are truly synthetic, that do not require the destruction of wood or cotton to make fibers, and that rely on no vegetable or animal sources but are chemical in all phases involved in their manufacture."

As showing the way to tomorrow's textiles, Dr. Harold described a method of making continuously a web simulative of the woven fabric known as tulle, which has been applied in the past, and points out how improvements in other directions may make this art feasible for broader application in the future. "Viscose or other rayon-making solution was poured upon a copper cylinder in which a mesh was deeply engraved. The cylinder rotated past a scraper knife and met a coagulating spray. On further turning, the weak but continuous net was doffed, carried off on a belt, washed, and dried. A good volume of business was done in the article. By suitable engraving of the cylinders the most attractive patterns in fabrics with lace and embroidery effects were possible, and by incorporating conductive graphite in the rayon mixture the entire fabric could be plated until the textile was a firm, metallic mesh of any weight desired or of any metallic composition. One can well imagine the beauty of Irish or Valenciennes lace given the adornment of three or four contrasting metals and a new endurance and solidity for fire or window screens, wall dadoes, or wainscotting. When the ideal synthetic resin comes, there may be the suggestion of the fabric of the future, made on the instant, as fast as textiles are printed. It would need no loom with its troublesome tedious beaming, drawing in, arranging the box motion, or cutting the Jacquard cards. With the speed of the photo-engraver which the American hunger for news has rendered unsurpassed, milady's dress would not only boast of beauty but of the actuality of news itself. She would be clothed not merely in the *dernier cri* but in the 9 o'clock edition!"—*D. H. K.*

## Exploding off the Bark

AN ingenious new use for explosives has been reported by foresters who have developed a quick and easy means of stripping insect-infested bark from pine trees. It was a slow and laborious process to strip such trees of their bark by hand until an explosive blasting fuse known as Cordeau was brought into play. Now, however, by a method as simple as it is effective, the task has been facilitated greatly.

Cordeau is a pliable lead tube about one quarter of an inch in diameter in which is enclosed a core of trinitrotoluene (TNT). For many blasting purposes it often is used in place of an electric current to explode practically simultaneously successive charges of dynamite. When a line of Cordeau is detonated at one end, the explosive impulse is transmitted through the entire length of this lead-enclosed fuse at a speed of about three and one-third miles a second.

it as one of the fastest transmitters of controlled impulse, next to light and electricity, its core of TNT cannot, however, be set off by friction, fire, or by any ordinary shock. This factor of complete safety has made Cordeau of extraordinary value in the preservation of bark-infested pine forests.

Any woodsman, however unaccustomed to the handling of explosives, can be entrusted with the spiralling of a Cordeau tube about an affected tree. Later, when the spiral of Cordeau has been detonated by a blasting cap, the bark of the tree will be scored and peeled off in strips which can be burned to prevent the breeding of such insect life and eggs as were not destroyed by the blast itself.

**"DOGS"**

**ONE and a half billion hot dogs—wienies—frankfurters—or whatever you call them—are produced annually in the United States alone. This production calls for over 100,000 miles of natural sausage casings.**

## Diesel Engine Jet Injury

AN entirely new type of industrial injury may be charged against certain types of Diesel engines. The danger is due to the very high cylinder pressures at which Diesel engines operate.

A California motor mechanic has recently had to have one finger amputated following an accident in which fuel oil escaping under high pressure penetrated the skin and led to dry gangrene.

The *Journal of the American Medical Association* tells of the industrial hazards caused by the introduction of high pressures in industry. The severity of these accidents is dependent upon the character and quantity of oil and upon the pressure under which it is introduced into the tissues, states Dr. C. E. Rees of San Diego.

The case Dr. Rees reports is that of a mechanic who was testing the jet of a Diesel engine. He was holding the jet, which he had removed from the cylinder head, about one inch from the tip of his right middle finger when he tripped the valve. Oil was forced from the jet into his finger at a pressure estimated to be about 4000 pounds. Intense pain, high temperature, hospitalization, gangrene, amputation—these were the aftermath of the accident. It was eight weeks before the hand healed.

Dr. Rees is of the opinion that, in the case of such accidents, a liberal incision should be made over the injured area to permit the irritant oil to escape.—*Science Service.*

## Crackproof, Ever-Plastic Caulking Compounds

IT is easy to realize how viciously destructive water can be if we recall the destructive floods of recent years. But few stop to think of the untold damage resulting from almost trivial and intermittent leakage through minor fissures, cracks, joints, and seams. For centuries, nature has defied man's efforts to protect and give long life to the structures he builds.

(Please turn to page 306)

# TELESCOPTICS

## A Monthly Department for the Amateur Telescope Maker

Conducted by ALBERT G. INGALLS

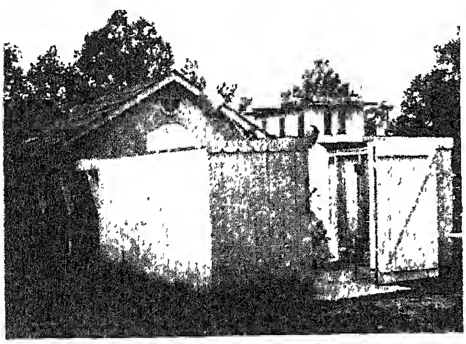


*Figure 1:* Jones' straight-line observatory

OBSERVATORIES built by amateur astronomers who have also made their own telescopes is the main course of this month's fare. They are all neat and attractive additions to the yards, landscapes, and house tops to which they have been added—therefore sure to impress the assessor on his next round and win a rise in tax assessment. Perhaps we seem cynical.

The first two are the straight-line type listed by Scanlon in the table of types at the end of his chapter on observatories, in the new book "Amateur Telescope Making—Advanced."

THE one in Figure 1 was built by Clarence T. Jones, architect, 210 Glenwood Drive, Chattanooga, Tenn., to house his 12" Newtonian. Two months ago we also published a description of a 20¼" Cass and observatory built by Jones and his sons Arthur and Bruce, with Paul Lewis, secretary of the local Barnard Astronomical Society. It now appears that Barnard was a native, not of Chattanooga, as was then stated, but Nashville, but that there are Barnard Astronomical Societies in both cities.

*Figure 2:* Mason's garage roof garden

ASCENDING one flight we reach the "penthouse" observatories, the one in Figure 2 being the work of William Mason, 1303 Lakeview Ave., Lorain, Ohio, author, by the way, of the chapter in ATMA on molding and casting forks for telescope mountings (p. 361). Mason says of his observatory: "I built it for my 12" telescope [the one shown in ATMA, same page—*Ed.*], and it is 10' by 10' by 6'2" and 6'8"—the two heights given being due to the slope of the garage roof on which it is built. The covering is '3V' sheet iron painted with aluminum paint. The telescope is mounted on a base of 12" seamless pipe filled with sand to lower the vibration period. No part of the garage or observatory touches it. Before I built it I thought I would like this type better than a dome; now I *know* I like it better."

ANOTHER penthouse observatory atop a garage is that of Charles A. Morrison, 39 Radcliffe Road, Rochester, N. Y. (Figure 3). He sends no description but the photograph suffices. The dome is 7' in diameter and is made of galvanized iron.

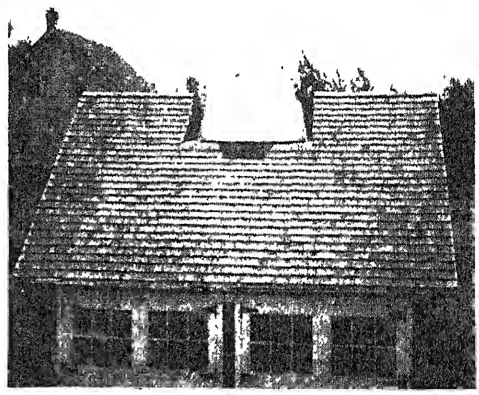
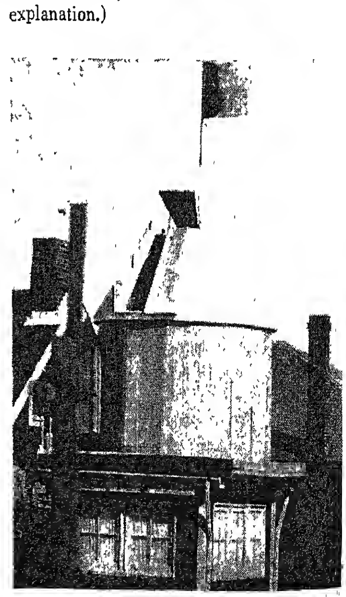


*Figure 3:* Morrison's penthouse observatory

AMONG the trials and tribulations of an amateur astronomer, moving an observatory is not a common difficulty. However, B. Topham, 105 Regent St., West Toronto 9, Ontario, Canada, moved a second-hand one by truck across Toronto. It measured 10'6" in height and 10'3" in diameter and appears to have proved about as difficult to transport as an armful of eels. First, it had to be hoisted in two parts over a 10' fence and deposited on the truck. Next, before it was scarcely started, it encountered two houses bordering a driveway, which gave a space only 9' wide. This impossibility was surmounted and then came an underpass which proved to have just 2" too little headroom. To beat this hazard, the air was let out of the truck tires. Arriving at its destination the observatory could not be set in place as shown in Figure 4 until the sloping roof of a wing of the residence was removed and a flat roof substituted. Topham had heard so much about heat insulation, he says, that he packed the ceiling timbers beneath with "rock wool," then laid his observatory floor as a separate entity upon the roof beneath. Then

he pulled the observatory up—another penthouse type—and there it sits—permanently, he hopes, after all the adventures mentioned. Perhaps it would have been easier to move the house to the observatory, but hindsight is usually easier than foresight. The dome is rotated by means of a gear working on a complete inner circle of Link-Belt chain. A ⅛ h.p. motor does the revolving.

SOMEWHERE in earth there is a Dr. Frank Welcher who built the dome shown in Figure 5. On the back of the photograph he sent are the statements that the dome is electrically revolved and houses a 6" Newtonian, but the address does not appear. (A great many persons put their addresses only on the outside of the envelope containing their communications, but in large offices incoming mail is opened by machine and only the contents are distributed by clerks to various desks. We occasionally receive an item which, because it bears no address, cannot be acknowledged. If we failed to answer *your* letter, that may be the explanation.)



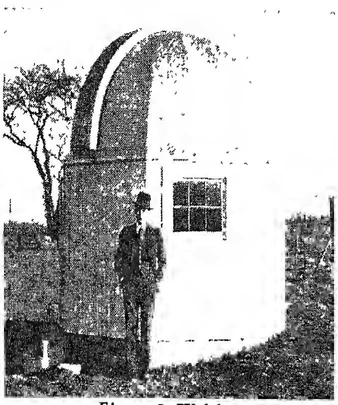


*Figure 5:* Welcher

ITS surroundings add to the attractiveness of the observatory shown in Figure 6, made by Henry E. Obermanns, 401 Hammermill Road, Erie, Pa., which he describes as follows: "It is 11′ outside diameter and 12′ total height. The dome rotates on old roller skates, with individual skate wheels to take up the side play. The shutter is in two sections, rolling back on the other half of the roof instead of opening sidewise. Thus I can expose the apex of the roof. The slot width is 24″. The telescope is mounted on a concrete post and base weighing two tons, and is steady notwithstanding the presence of a paper mill and railroad within one block. The cost was about $100 for materials (concrete, wood, 26-gage sheet metal for roof)."

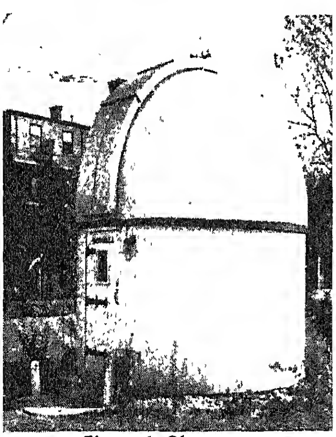


*Figure 6:* Obermanns

A BRIEF description and photographs of an observatory operated by two Jamestown, N. Y., amateurs who are said to be too modest to blow their own horn, is sent us by Leon Laskaris of Warren, Pa. Figure 7 shows the exterior of the dome and Figure 8 the interior. Bert Hansen, 530 Stowe St., and Marshall Hedstrom, 519 Stowe St., both of Jamestown, are the two. The observatory is that of the Jamestown Astronomers' Guild, which has about 25 members, but the local public has the use of it two nights a week. "The aforementioned pair of hardworking Swedes," Laskaris writes, "made the 10″ telescope." Microscopic examination of the original photographs of the above seems to indicate a metal roof with seams both inside and outside. The porthole in the door is interesting, and this might be a good way to dispose of astigmatized disks of glass.

THE dome in Figure 9 was made by

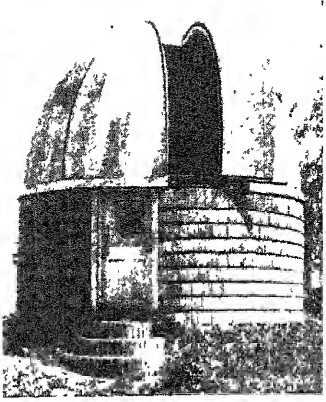


*Figure 7:* Jamestown Guild

Upper Green, Mitcham, Surrey, England. "It is 10′ in diameter," Harold Cox writes, "and is built of ash hoops, slats and canvas. The opening, when the doors are fully pushed back, is 66″ wide. In the picture the doors are shown half open. We had this opening made this width owing to the spread of our camera and telescope, and if you know of anyone who is looking for fun, get him to make a dome with an opening more than half the total diameter. With such wide doors we had to make them curved in both directions, for the sake of appearance, and we also had to fit special outriggers to carry the run-off track." The illustration is dark in the lower parts but close study of the original photograph with a magnifier shows, first, the lattices which are seen in front: this is apparently a fence and gate well outside the observatory building, with a walk

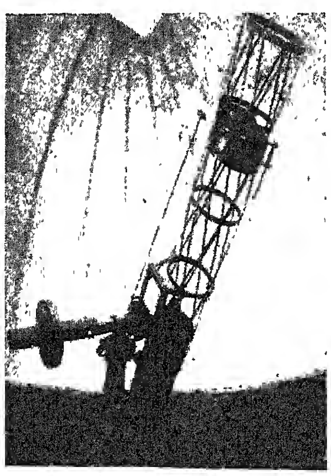


*Figure 8:* Jamestown, interior

between it and the building. Next, beyond this opened gate, is the low hinged door to the observatory proper and, as the dome ring above it is apparently not cut, the users evidently duck under. The 'scope mounted inside is the 12″ that was shown in these columns last month.

In Milwaukee, at 807 East Otjen St., lives a man named Walter Houston who sends the photograph shown in Figure 10. Minikani Observatory is the property, evidently, of the Milwaukee Y.M.C.A. Houston omits to say whether he built it or not. Let's assume that he did, but

He writes: "Dome 13′ diameter: covered with 28-gage iron. Dome frame of ¾″ pipe bent to curve; wood strips steamed to fit pipe and held with pipe clamps; iron nailed to wood strips. Wooden ring at bottom built of two layers, 16 blocks to a layer; pipe fastened to this ring with floor flanges. Building octagonal; 10″ beveled siding; eight 6″ posts set in concrete; 2″ x 6″ sill on top; stone foundation for looks alone. Horizontal strip of 18-gage iron around dome ring and extending 5″ below. Rotation afforded by roller-skate assemblies. Two sets bolted to 3″ angle iron, one for vertical thrust and one for horizontal thrust, make up an assembly. Vertical thrust against lower surface of dome ring, horizontal thrust against lower portion of the aforementioned horizontal strip of

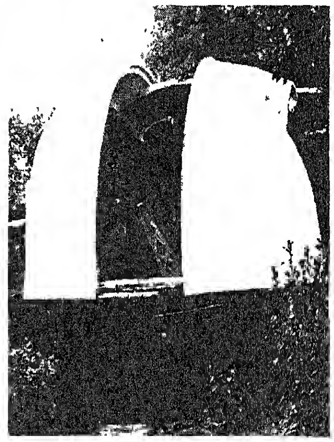
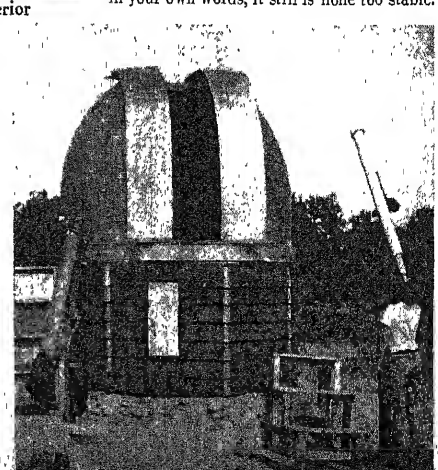


*Figure 9:* Cox and Cox

iron. Eight assemblies support dome. They are fastened to sill on top of posts.

"Floor 2′ off ground. Shutters operate conveniently; rollers in angle iron on bottom; barn door hanger system on top. Cost of observatory, a little over $50. Instrument, 10″ reflector; reaches 15.4 magnitude on the Harvard scale. Outside, 4″ Harvard refractor; 4″ $f/16$ reflector by George Knott (13 years old, the boy)."

From Fred Shunk, 923 Birch St., Scranton, Pa., we have the following communication. "You have repeatedly called attention to the necessity of designing rigid telescope mountings. Here is one mounting you cannot criticize on that score (Figure 11). It was devised after long and bitter experience with the usual flimsy type, and was meant to be absolutely rigid—and is; yet, in your own words, it still is none too stable.



This photograph shows our 6", short-focus Newtonian, driven by a concealed Diesel engine. Partly sincerely yours——" Commenting on this picture, R. W. Porter says, "I couldn't drive the idea home better myself." But we still think the tube a shade too flexible—though if used as an RFT and held in the arms, this might not matter so much.

FROM C. A. S. Howlett, 127 Lawnside Ave., Collingswood, N. J., we have the descriptive outline of a "proposed non-stop round trip to the moon," with drawings, and with it the request that we mention it here. It turns out that Mr. Howlett, who gives illustrated talks to "resort hotels, women's clubs, student assemblies, parent-teacher associations and technical organizations" (thus saith the circular he sends) holds that the earth is a hollow sphere with the moon at the center, and he proposes an 8000-mile "stratosphere" flight encircling the moon and back to earth. In his lectures he will discuss the question of establishment of right of ownership of the moon, to increase our nation's public domain and provide fat profit for the promoters of such a trip. He suggests that the moon may be surcharged with valuable minerals. Here is a chance for the overworked secretaries of amateur astronomical clubs to date up a lecture that would, no doubt, provide *considerable* interest before the evening was over, especially if discussion followed the lecture! With a good telescope, on this system, it ought to be quite easy to watch the war in China, just across on the opposite side of the earth.

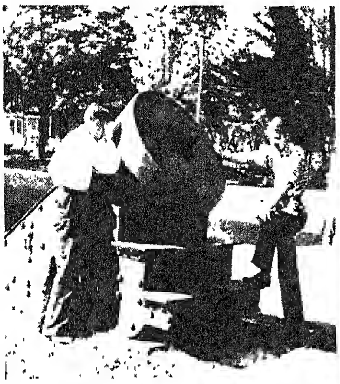


*Figure 11:* The Scranton mounting

TWO items swept up in our reading: "Emery consists of minute crystals of naturally fused aluminum oxide held together by a matrix consisting largely of iron oxide."—D. H. Killeffer, "Sandpaper Grows Up," in *Industrial and Engineering Chemistry*, August, 1937. "On a clear still night the temperature trace from sunset to sunrise approximates very closely to a parabola."—Prof. D. Brunt in *Journal of Geography* (London).

THIS month we re-christen this department with a composite name. There has been no single word that would describe the telescope making hobby. The word "optics" is broader and, moreover, persons not scientifically minded usually accept this word in the special connotation of eyeglass optics. We wish some reader would cook up a brand new word that would connote the real McKay—the tenth-of-a-fringe kind of optics. (This kind superfluous in eye

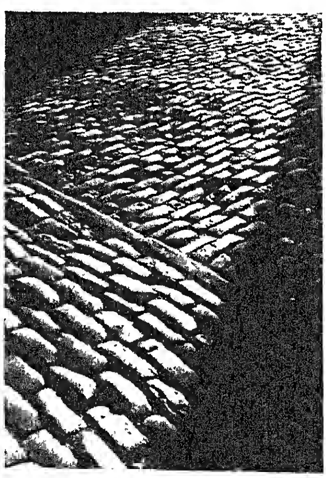
# CAMERA ANGLES

Conducted by JACOB DESCHIN

## Streets Have Character, Too

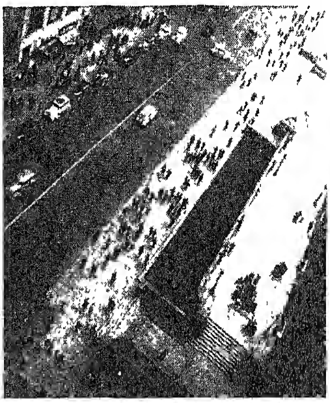
IN the poetic sense, at least, there is no such thing as a dull street. If it is dull at the noon hour, when the high sun bathes the sidewalks in a monotone of harsh light, none but the impatient and unimaginative will fail to study it at other times of the day, before giving it up as a bad job, and to observe at leisure the manifold transformations of which it is capable. The photographer in search of the pictorial is often struck with pleasure and surprise at the unexpected beauty revealed in a street after many previous fruitless attempts to find something worth photographing.

You may have observed on your own street how different it looks in the morning as you leave home for the office from the picture it presents in the middle of a Sunday morning, and how varied are its aspects at different times of the year, under the influence of the various seasons and under varied lighting conditions, both by day and by night. Do not condemn your own street as lacking altogether in pictorial appeal. The grass may be greener than you first imagined.



"Old Quarter"

To grasp the essential character of a street or corner, avenue or thoroughfare, you must see it many times and observe it studiously. It is a slow, contemplative labor of love, not for the man in a hurry but for him who sees more than the surface of things. It is for him, indeed, who wishes to record in the most attractive, understandable way, an interpretation of how he feels about certain aspects of life. For what, after all, is a photograph if it is not a way of speech, speech through the medium of a picture? A writer turns out a beautiful piece of prose and we are touched

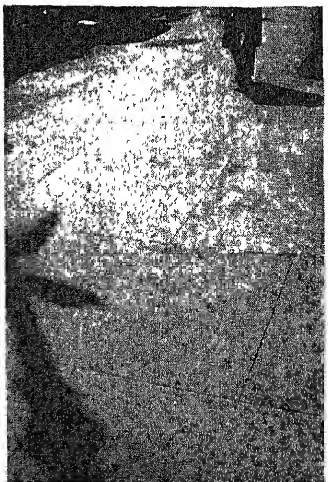


"Fifth Avenue"

to us through the medium of words unusually well put together; the painter, the musician, the playwright each in his own way, through his own particular medium, makes us think his thoughts, feel his emotions, see old things in new ways, ways we had never experienced before.

A few attempts to indicate the possibilities of street photography from the point of view of the street or thoroughfare itself and not, necessarily, the activities that transpire in it, accompany this article.

In "Old Quarter," which was taken in a thoroughfare near the piers late in the afternoon, the low sun shooting through an aperture created by jutting buildings and other structures gives the effect of a soft spotlight sweeping across the worn cobbles, suggesting the atmosphere of the title which we have given the picture. This is one of these fortunate circumstances when a subject, at other times dull and pointless, assumes possibilities by virtue of unusual lighting.



**DON'T FORGET**

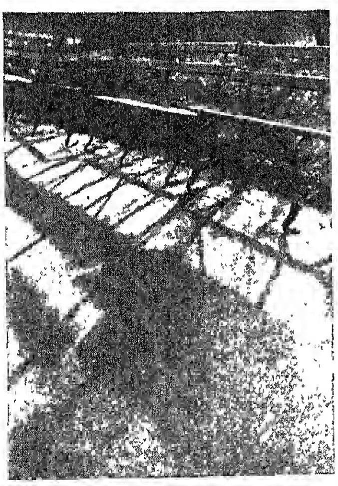
to enter the new

**PHOTO CONTEST**

that Scientific American is conducting.

Closing date is December 1, 1937
See our September Issue for full details

"Fifth Avenue" is an example of a street picture without shadows. Taken from the 15th floor of a New York skyscraper, it illustrates what can be done even when the sky is dull. On the particular day when this photograph was made, the sky was overcast and it almost seemed as if the day were lost for street pictures, where shadows are ordinarily a great aid. But, on the contrary, this particular picture seems better without shadows. The people stand out where they might have almost merged with their cast shadows, one gains a clearer impression of pedestrians on their way up and down the avenue, and there is a general cheerfulness pervading the scene



"The Park"

that often is associated with the street famous throughout the world as Fifth Avenue.

"Streets Paved with Gold" is a phrase familiar to persons who have come to America from foreign countries. There the legend used to persist and it may even today, for all we know, that in the Land of Opportunity such prosperity reigned that even the streets were paved with gold. At a particular corner which this department frequently passes, we noticed, both at night and during the middle of a sunny day that when standing at a certain angle in relation to the light, sparkles like stars or brilliant diamonds appeared in the sidewalk. The Old World legend came to mind and the picture was the result.

"The Park" depicts the familiar wide walk created for the leisurely stroll; the long shadows cast by the empty benches, together with the benches themselves, support the impression of a park walk. The picture was taken in late afternoon, of course, and without people. It was intended that the park walk should speak for itself.

## Introducing Infinol

HERALDED as "the result of years of ceaseless experimentation, study, and research," and "not the inspiration of an evening's mixing of chemicals," a new fine-grain developer called Infinol is now available. The developer is the achievement of G. Bert Ward, widely known in the field of motion-picture processing. This fact should speak volumes for the new developer for everyone knows what an important part fine grain plays in the processing of motion-picture film.

Notwithstanding the fact that practically all recent ultra-fine-grain developer producers have felt it mandatory to include the chemical paraphenylene-diamine in their formulas because of its undoubted fine-grain capacity, the deviser of Infinol disowns this chemical and follows his own counsel. The result is a developer reputed to have the following characteristics:

A grain as fine as the finest working surface developer; quality equal to borax negatives (which have the characteristics of producing good tone values and blocking the highlights only in over-exposure); full density with no additional exposure; will not stain; does not contain irritating poisons; will develop more films per unit volume than other developers; may be compounded with ordinary tap water; is a full control developer, giving contrast control with time; will not block highlights.

In addition, Infinol is said to permit a full 50 percent higher meter rating than other fine-grain developers, since excess exposure is not required to obtain detail in the shadows, and the negatives it produces, according to the claims of the sponsors, are more "meaty" with clean highlights and a wealth of detail.

## Leica Exhibit Postponed

THOSE intending to send Leica pictures to the Fourth International Leica Exhibit announced in this department last month now have an additional month in which to submit their entries, namely, to November 30, due to the fact that the date of the exhibition has been deferred to January of next year. The new date is January 8 to 18, inclusive, and the place is the mezzanine floor of the International Building, Rockefeller Center, New York City. E. Leitz, Inc., the sponsors, explain that "this change in schedule was brought about by the fact that a more suitable exhibit hall was available for the later dates, one which would display to better advantage the many outstanding prints selected for this exhibit."

## Caveat Emptor

"LET the buyer beware" or "Watch your step"; when a hobby enjoys such tremendous popularity as that now accorded the camera, be on your guard for the dishonest dealer, the "bargain" buy, the "chance of a lifetime." Look with suspicion on the offer of a camera at a much lower price than that usually asked for it. There's probably a nigger in the woodpile somewhere. A camera that may seem a bargain at first glance may actually prove to be the costliest purchase you have ever made.

The vultures prey on the gullible and take wicked advantage of wholesome enthusiasm. There is probably no field today in which sales resistance is so low as in the camera

field. Time and again you hear the statement made that you can sell the amateur photographer anything on sight. This is, of course, considerably exaggerated, but there is an element of truth in it. What this actually means is that the amateur loves his hobby so well that his ordinary buyer's caution is temporarily dormant and he makes his photographic purchases, in a large sense, emotionally.

In the main, photographic dealers, in the smallest as in the largest town, are straight shooters. They want you to be satisfied and they are jealous enough of their reputation to give you a square deal every time. The dealer has other things to sell and obviously he wants you to come back to him and not go to another dealer because he misrepresented some item to you or misled you in some other way. You have to put your trust in the dealer, particularly if you are buying your first camera or your first in a new field, such as a miniature, if you have been used to a larger camera outfit. But be sure your dealer is trustworthy.

## Du Pont Spool for Robot

DAYLIGHT loading film spools for use in the Robot camera, the camera designed to take pictures in rapid sequence without rewinding the shutter for each shot, are being made by the Du Pont company, famous for their Superior and Micropan emulsions for miniature cameras.

This is another instance of a co-operative spirit between film and camera manufacturers that redounds eventually to the benefit of the ultimate consumer, the camera user, as well as those commercially involved. As soon as a new camera has made the grade of popular acceptance, some film manufacturer comes along with a helping hand in the matter of film supply, the "cannon fodder" without which the camera is useless. And so it is with the Du Pont-Robot tie-up. May the union prosper.

## Lenzal

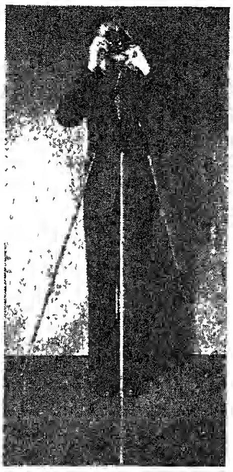
A NEW lens cleaning fluid has been placed on the market under the trade name Lenzal. The bottle of Lenzal is sold as a unit with a special applicator and Japanese lens paper, and is recommended for use in cleaning camera lenses, eye glasses, binoculars, microscopes, hand lenses, reading lenses, monocles, condensers, telescope lenses, color filters, range finders, exposure meters, and similar items which call for extreme care in cleaning. Lenzal is declared by the makers to be free of "acetone, carbon tetrachrode, alcohol, alkalis, acids, oil of turpentine, benzene, soap, or ether, or such ingredients that are so common in the ordinary lens cleaners."

## Man-High Tripod

THE requirements of a good tripod are pretty well known among camera users who have had occasion to employ them in taking pictures requiring greater exposures than snapshots, in making color separation negatives, in delayed action shots, and for other purposes. The tripod must be rigid enough to remain immovable during the time of the exposure, whether for a fraction of a second or several minutes; it must be tall enough when fully extended to allow comfortable viewing on the ground-glass back or

heights for different subjects without the necessity of tilting the camera down; it must have a tilting top for tilting up or down when desired; it must be portable, fairly lightweight, short, and strongly built.

All of these features appear to be embodied in the 79-B All Purpose Tripod. It is unusually long, including seven telescopic sections extending to a maximum height of 62 inches, raising the camera and sights to eye level; it has a built-in swivel top, which



Man-high

means insurance against accidental loss of the swivel top or absent-mindedly leaving it behind somewhere; its tubular brass construction means strength and durability and it is very convenient for carrying about, measuring only 18¼ inches when closed.

The *illustration* shows the *tripod in use.* Observe how the operator, employing a range finder camera, the Rollop, is able to work without stooping or strain. Incidentally, the illustration demonstrates the proper way of employing a tripod, one leg forward, the other two legs on each side, permitting the operator the freedom of the space between and thus guarding against accidentally knocking one's legs against the tripod supports and disturbing the focus.

## INSURANCE FOR YOUR CAMERA

TIME was when most amateurs were content with cameras costing under 25 dollars or so. Today it is a common thing for a man to spend as much as 200 dollars or more on one or more cameras. Few people, however, seem to realize the importance of protecting them against loss and theft in the same way they would protect any other valuable possession; namely, insurance. Camera thefts are reported quite often these days and what of the hazard of leaving a valuable outfit in a train or in a hotel and never seeing it again?

You can insure your camera possessions, just as you can insure anything else, by a so-called "camera floater" policy, which protects your camera wherever you happen to have it, at home or away on a trip or on the way from home to office and back; in short, anywhere. The cost is two dollars per 100 dollars, insurance being issued for sums not less than 200 dollars. This cost is for the "world-wide" form which protects your camera wherever you happen to be, in this country or out of it, and is fairly reasonable considering the feeling of security one obtains

thereby. For those hardy ones who take to the air for pictures, it will be interesting to know that a special form may be obtained to protect the camera while being used during airplane trips.

## Cash Prize Contest

A MONTHLY cash award of 10 dollars for each of the five best photographs submitted during each month is announced by the distributors of Perutz film in this country, the Intercontinental Marketing Company, 10 East 40th Street, New York, N. Y. The awards are to continue indefinitely, the sponsors also being prepared to purchase any negatives worth using for publicity purposes.

The only condition of entry is that the pictures submitted must have been taken on Perutz film during the course of the six months preceding entry.

"Obviously any pictures submitted must be good, both pictorially and technically," the announcement says. "You may enter any time, and you may submit as many pictures as you like. Every type of picture is eligible, and particularly, good snapshots of river scenes; week-end parties; happy people bathing, sailing, and indulging in every kind of sport and games; children; animals—in short, everything that truly and naturally mirrors life."

If you wish further details, it is suggested that you write to the Intercontinental Marketing Company at the above address.

## When Nature "Emotes"

GUESS the title "Agony" is a pretty sad one to hand you this fine autumn evening, but that's the way this picture appealed to us as we snapped it. The branches seem to writhe as if in pain, displaying their misery across the sky. Whatever you may think of this particular picture, there are many such opportunities for picture-taking, and whether you are cheerfully inclined or otherwise you, too, would have snapped this tree if you had run across it. Of course, the early spring or late fall or winter, when the leaves have left the trees, are the only times of the year to do justice to this subject. In this particular case, in order to eliminate as much of the background landscape as possible, it was necessary to shoot up from a low vantage point against the sky background, a yellow filter being employed.

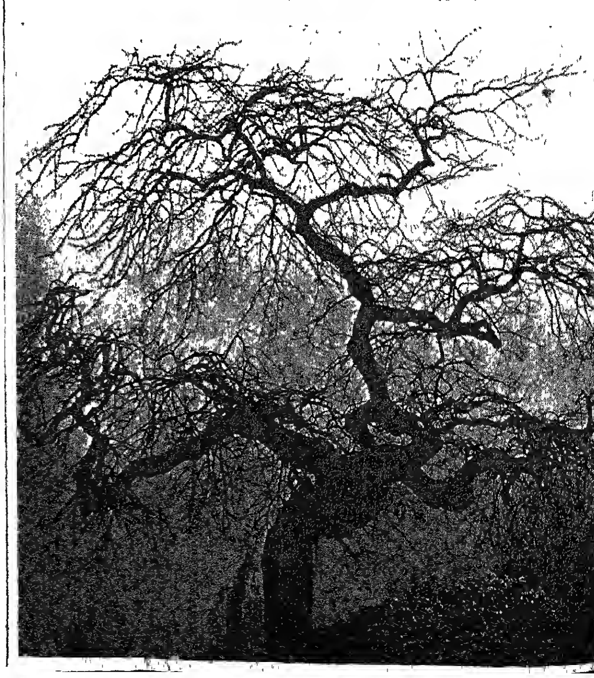
## Instocine for Movies

WITH the demand for the Instoscope visual extinction exposure meter showing no signs of abatement, a twin Instoscope called the Instocine, for the exclusive use of movie camera owners, has been designed by Joseph M. Bing, F.R.P.S., inventor of the Instoscope.

The Instocine, which is the result of a steady demand on the part of movie makers for a meter of the type and low price of the Instoscope, operates on exactly the same principles as the Instoscope, with the exception that the scale is exclusively cinematic. The Instocine is operated with one hand and quickly shows, for both monotone and color exposures, every cine camera stop for any "number of frames per second" and any "number of frames per second" for every cine camera stop, with the most frequently used "16 per second" row displayed particularly large in red figures on a white ground.

## Miniature Cameras Have No Rising Front

THIS title is not a piece of news, but you'd be surprised how many people insist on throwing this fact in the face of miniature camera enthusiasts as one of the serious drawbacks of the minicamerist's art. When it is explained that miniature camera designers have enough problems to contend with in the construction of the midget marvels without worrying their heads about rising fronts and that the lack of this feature is not really so serious a drawback as the rising-front-for-the-miniature propagandist would make it appear, the defense still



proves unconvincing. The fact is that, while a rising front is a really necessary feature of the larger cameras, in the miniature it is not an absolute essential since it is possible to give a slight tilt to the miniature without causing any serious distortion and that even where this occurs it is the simplest thing in the world to correct the distortion under the enlarger by tilting the easel in the direction opposite to that of the tilt in the negative. Another way around the difficulty is the use of a wide-angle lens which relatively covers a greater area in all directions than the normal lens, and then enlarging only the essential part of the picture.

## Hazards of Buying Cameras Abroad

A CAMERA, like any other relatively complicated piece of machinery, needs expert attention occasionally. Things are bound to go slightly wrong now and then, requiring only a small adjustment but requiring that adjustment very badly. Every importer of cameras has facilities, more or less efficient, as the individual case may be, but facilities of which the user of a particular camera may avail himself at any time. The importer of a camera stands back of that camera and will make good any original defect that may later develop in use. Naturally, if the fault is that of the camera owner, the importer cannot be expected to stand the cost of a repair due to the operator's carelessness or failure to follow instructions for use.

However, if you purchase a camera abroad, you have no claim on the importer. He will make adjustments for you and repairs, but he will charge you for the slightest service. After all, it is not his responsibility, even though the camera is made by the same factory. The importer goes to a great deal of expense in advertising the camera throughout the country, in publishing literature, in maintaining a staff. He does all this on the natural and rightful assumption that he will eventually sell some of his importations and thus make a reasonable profit as a result of his investment.

## Kodachrome in Italy

TOURISTS from the United States may now expose Kodachrome film in Italy and still have it processed in Rochester, despite a long-standing regulation prohibiting the exportation of unprocessed motion picture film, according to a recent ruling.

"No laboratory for processing Kodachrome film is in operation in Italy," the Eastman report says, "and, as Italian authorities require official inspection of all motion picture film before it can be sent out of the country, tourists have been obliged to confine their photography to black and white film which can be processed in the Milan laboratory.

"Those desiring to make Kodachrome pictures in Italy should apply to the Italian Tourist Information Office, Rockefeller Center, 626 Fifth Avenue, New York City, where they will be given a letter to the proper authorities in Rome. After the film has been exposed it should be delivered to the official designated in the letter who will forward it to Rochester for processing. The processed film will be inspected by the Italian consul and then mailed to the owner's home address in the United States."

## THE SCIENTIFIC AMERICAN DIGEST

*(Continued from page 295)*

The value of a crackproof putty and a non-hardening caulking compound which are permanently plastic, adhesive, and waterproof can readily be appreciated. Consider those stubborn joints where the kitchen sink meets the wall and drainboards, where the bathtubs touch wall tiles or plaster, where window and door frames set into building walls. Think of the dried out and cracked putty on windows, of leaky flashings, of linoleum which refuses to stay put on damp cellar floors or on dried-out wood floors, of the ugly openings between the fireplace and walls and between the hearth and floor, of the loose tiles in the kitchen and bathroom.

A series of ever-plastic compounds has recently been made commercially available by Ever-Plastics Corporation, for the express purpose of putting an end to these various troubles. The compounds are based upon a plastic carrier in combination with an adhesive resin and asbestos and mineral fillers. Certain variations and adjustments in formulation fit each compound to a specific use. For special purposes a large user can obtain a compound especially adjusted to his requirements. For general distribution, five compounds have been standardized so far. One of these, named Tilon, is white and particularly adaptable to bathroom and kitchen uses in setting tile and filling cracks and joints. It is extremely adhesive and being permanently plastic, expands and contracts, thereby keeping the joint filled at all times. Within a week, a tough, smooth, elastic skin forms, which can be painted or lacquered to match adjoining colors. For glazing and filling exposed cracks another compound called Putite is furnished. For regular caulking, a softer material, Caulktex, is made which can be used with either knife or gun. For horticultural work another compound named Graftex is proving valuable because of its property of adhering to damp wood surfaces and bleeding wounds, giving perfect protection through winter cold and summer heat despite continual flexing and bending.

A concise, authoritative description of these materials is found in the specification used by certain departments of the Government when buying the company's compound for setting sanitary fixtures. The specification reads as follows: "An asbestos composition filler which is a germicide, absolutely gas- and fume-proof, water-tight, stain-proof, containing neither oil nor asphaltum, and which will not rot, harden or dry under any extreme of climatic change. It will adhere on a damp surface."

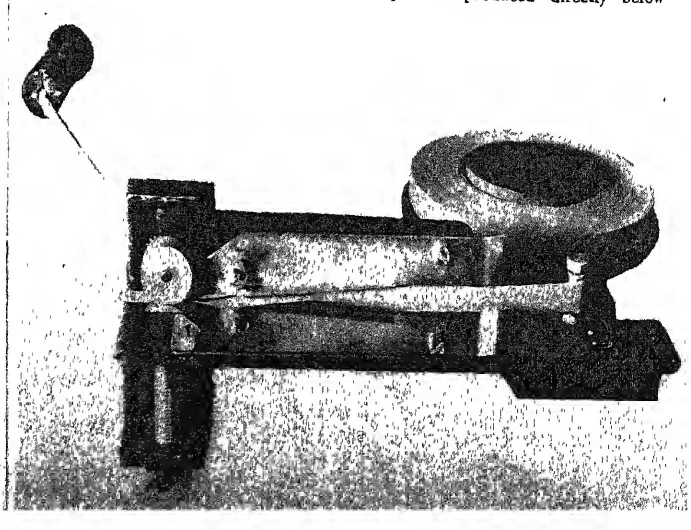
### PURIFYING MINERALS

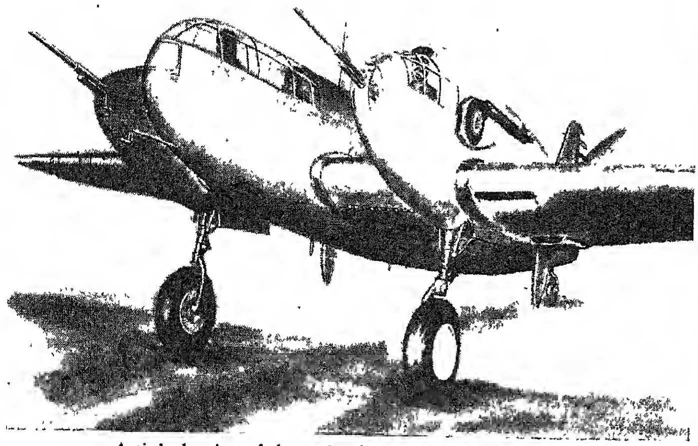
APPLICATION of the process of froth flotation to low grade barytes eliminates iron and silica impurities and substantially increases the value of the mineral. By this method certain deposits in Tennessee and South Carolina, which are too impure to be of commercial value without treatment, are made useful sources of this mineral. The process was developed by the U. S. Bureau of Mines. Barytes is a widely used white pigment and a source of barium. —*D. H. K.*

### BINDING TO PROTECT VALUABLE PAPERS

A SIMPLE crank-operated device has just been placed on the market as a means of protecting the edges of valuable papers, drawings, maps, and the like. The edge of the paper to be protected is passed between two rollers while a tape of gummed heavy paper or of gummed vari-colored Cellophane is pressed tightly over the edge

*Above:* **Applying a gummed binding to valuable papers with the device that is shown, close up, in the photo reproduced directly below**





Artist's drawing of the multi-place XFM-I, described below

to make a quarter-inch border. This effectively prevents tearing of the edge. No heat or moisture is needed and the machine will tape outside curves or disks.

The Vertex Company that makes this device recommends it for architects, engineers, lawyers, insurance companies, and many others, including orchestra leaders who may wish to protect the edges of much-handled music sheets.

## A Formidable Multi-Place Fighter

A SINGLE-SEATER pursuit plane, no matter how fast, is no longer a match for the formidable flying fortress that the modern bomber has become. Accordingly the Army Air Corps has given encouragement to the experimental construction of a radically novel, more powerfully manned and armed multi-place fighter, the XFM-I, which has been designed and built by the Bell Aircraft Corporation. The artist's sketch gives a very faithful presentation of this new and dangerous craft.

The first important departure from convention lies in the fact that the machine is a pusher, with both propellers behind the wings. The builders claim greater efficiency for this arrangement, but that is debatable. What is indeed gained by the pusher arrangement is that the wing gunners, one ahead of the wing on each side, have a free field of observation and fire in front, unimpeded by engine or propeller. Also, the gunners do not have to work in the blast of the propeller, a serious handicap to efficiency.

Our somewhat romantic idea of a pursuit pilot is that he is a lone fighter flying a relatively small airplane, yet capable of bringing down single-handed a huge bomber or a giant airship. When the bomber itself is sufficiently fast and mounts enough guns the task becomes too formidable even for a Bishop or a Rickenbacker. Therefore, the new fighter accommodates a crew of five—pilot, co-pilot-navigator, radio-operator-gunner and two outboard wing gunners. Another innovation which is looked on with favor in military circles is the complete interchangeability of any or all members of the crew. The wing gunners can move from their stations to the main fuselage while in flight; the co-pilot can change places with the and all stations have means of inter-communication. The ship carries a total of six guns. No information is given as to speed, but the Air Corps rightly says that a flying machine must be faster than its target and that the XFM-I is considerably faster than the bombers it is to encounter. Hence we can guess at a speed of more than 300 miles an hour.

There is an auxiliary power plant on board which drives nine electric motors for such duties as retracting the landing gear, lighting, radio transmission, and starting. The possibility of continuing radio transmission after a forced landing has obvious advantages.

It is significant that the twin-engine power plant comprises the new Allison liquid cooled motor (see page 308), which delivers 1000 horsepower. We have predicted that as soon as a really modern liquid cooled engine was available, it would be eagerly put into service. The new fighter is a confirmation of this prognostication.

It is hardly necessary to say that the machine is aerodynamically clean, the landing gear and tail gear are retractable, flaps are used, the cabins are heated, and so on. Many things in the construction of aircraft are now taken for granted that would once upon a time have created excitement by their novelty.—*A. K.*

## What the Test Pilot Does

A REMARKABLE young man who undertakes the hazardous duties of a military test pilot (that they are hazardous those of our readers will agree who remember the death of Jimmy Collins in a dive test some two years ago) not because of the pay and not because of the glory, but because of his great love of flying and his immense interest in aircraft development work, is James B. Taylor, Jr.

His latest test work was putting through its paces an all-metal Seversky low-wing monoplane, developed for the Navy as a single seater pursuit for service on board the aircraft carriers.

One of the series of tests is to dive from an altitude of about 16,000 feet to about 8000 feet and in pulling out to develop safely 7½ times g, the acceleration due to

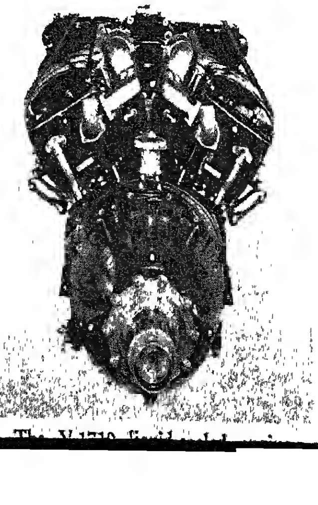
craft must be seven and a half times its normal weight. Mr. Taylor has successfully completed these tests and newspaper reports have it that a speed of 530 miles an hour was attained during one of the dives; instead of the required $7\frac{1}{2}$ *g*, the load measured by the accelerometer was actually $8\frac{1}{2}$ *g*. It must be remembered that it is not only the ship which is subjected to this tremendous strain. The flesh-and-blood pilot is also subjected to the same dynamic forces. At the final instant of recovery he may be forced down into his seat with a momentary weight of three quarters of a ton. We congratulate Mr. Taylor and the constructors of the Seversky ship on satisfying the Navy observers and we sincerely hope that Mr. Taylor's freedom from mishaps will continue.—*A. K.*

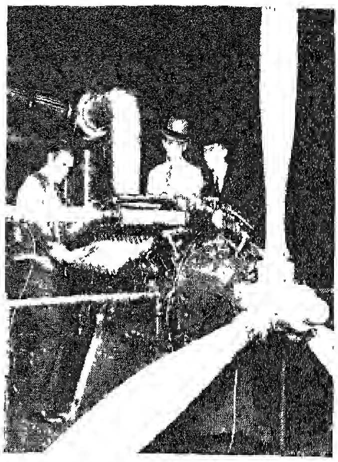
## A Splendid Liquid-Cooled Engine

Hitherto American aviation has led in the development of air-cooled engines—Europe (particularly Great Britain) in liquid-cooled engines. Such a situation has been a constant source of irritation both to the government services and to the designers of military and naval aircraft. With the passing of the Army's 150-hour type test by the V-1710 aircraft engine, built by the Allison Engineering Company, we are at least on a par with foreign development in the liquid-cooled field.

Perhaps the most striking feature of the V-1710 is its successful use of ethylene glycol as the cooling agent; it is undoubtedly the first motor designed specifically for use with this synthetic coolant. Ethylene glycol (sometimes called by the trade name Prestone) has a low freezing point, and at the same time a much higher boiling point than water; namely, 387 degrees, Fahrenheit, as compared with the 212 degrees of the latter. Hence the Prestone radiator can work at a much higher temperature with Prestone than with water. And if the radiator works at a higher temperature, then it delivers heat much more effectively to the air passing through its cells, and can be made smaller and lighter. Since it is smaller, it has less head resistance.

Coupled with the radiator of less head resistance, the new engine, a 12-cylinder V-type, has a remarkably small frontal area—less than six and one quarter square feet. Air-cooled engines of similar power have a frontal area of about 16 square feet.





Engineers inspecting the Allison liquid-cooled engine while on test

It is true that air-cooled engines, skilfully enclosed by the N. A. C. A. cowl, are lighter than even this latest liquid-cooled motor, more compact, free from 'plumbing,' and of remarkable efficiency. Nevertheless, the availability of such a V-type liquid-cooled engine, with its low frontal area and small radiator, will be most tempting to airplane designers. They will immediately seek to make full use of its possibilities, endeavor to hide the complete engine within the wing, or else seize on its splendid form to give the front end of the fuselage a much better streamline form than is possible with the very large air-cooled motors. They will also, particularly in single seater fighters, grasp the opportunity of giving the pilot much better vision ahead.

We shall in the future see the liveliest competition between the air-cooled and the liquid-cooled types, and competition in aircraft design means progress—just as competition does in every other form of human activity.

Engines employing ethylene glycol have been built before, but have never been entirely successful. The Allison has made good because several years of the most careful experimentation have preceded the final tests. In particular, the rates of flow of the coolant and the temperatures at all points around the cylinders, valve seats, spark plugs, and so on, were very carefully studied. Uniform cylinder and head temperatures were thus secured. This painfully acquired knowledge also gives the engine flexibility in regard to octane ratings of the fuels employed as well as choice of compression ratios. We may conjecture also that due provision has been made for the expansions due to the higher working temperatures than with water cooling, so that pistons do not seize up. Such difficulties were encountered in earlier Prestone-cooled designs.

In other respects the engine is of excellent, but conventional design. Space will not permit a detailed description, but one or two features deserve special mention. Thus, the 2 to 1 reduction gear is built into the engine integrally and gives a very neat front end. The reduction gear consists of an internal spur gear, which meshes with a pinion gear on the crankshaft. The reduction gear, together with the propeller shaft, are encased in a single aluminum casting which forms the nose of the engine.

also built into the engine and can be located immediately under or to either side of the engine with a short exhaust line and short air pressure lines to the intercooler and carbureter. The accessory housing for the cooling pump, camshafts, fuel pump, vacuum pump, and so on, is also very neat and is mounted directly on the rear of the crankcase.

The neat appearance, relatively small size and small frontal area of the engine can be noted in our two photographs.

A brief summary of the specifications is as follows: Bore, 5.5 inches; stroke, 6.0 inches; displacement, 1710 cubic inches; overall length, 95 inches; overall height, 51 inches; overall width, 29 inches. Normal and take-off rating, 1000 horsepower at 2600 revolutions per minute on 87 octane fuel. Compression ratio, 6 to 1. Blower ratio 6.75 to 1. Reduction gear 2 to 1. Weight with magneto, carbureter, cooling pump, stacks, fuel pump, and so on, 1280 pounds—only 1.28 pounds per horsepower.—*A. K.*

## A Single-Blade Variable-Pitch Propeller

THE new Sensenich-Everts single-blade variable-pitch propeller, which is seen in one of our photographs mounted on a Fairchild cabin plane, has given much satisfaction to pilots. Its principle is as ingenious as it is simple and is illustrated by the diagrammatic sketches. The blade is balanced, statically and dynamically, by a counterweight, which is essential for avoiding vibration. The propeller is driven by the engine shaft CC in the usual manner. But, and herein lies the secret of the device, the blade is also free to pivot—within certain limits—about two other axes, BB and AA. The pivoting is by means of pin-hinge mounting of simple character.

In the smaller sketch is shown how this limited freedom about the two axes permits the blade pitch to adjust itself automatically to the correct value. The blade is really free to feather about the intersection of the axes BB and AA. The centrifugal force tends to increase the pitch; the air load or thrust tends to decrease the pitch.

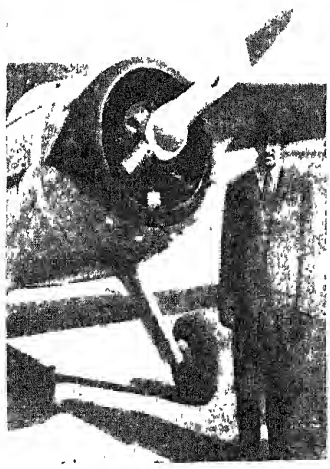
At take-off the thrust is very large, the moment of the air load overcomes the moment of the centrifugal force and the pitch decreases, as it should do.

At high speed, the thrust is much smaller and the centrifugal force moment now takes charge with increase in pitch—which again is as it should be.

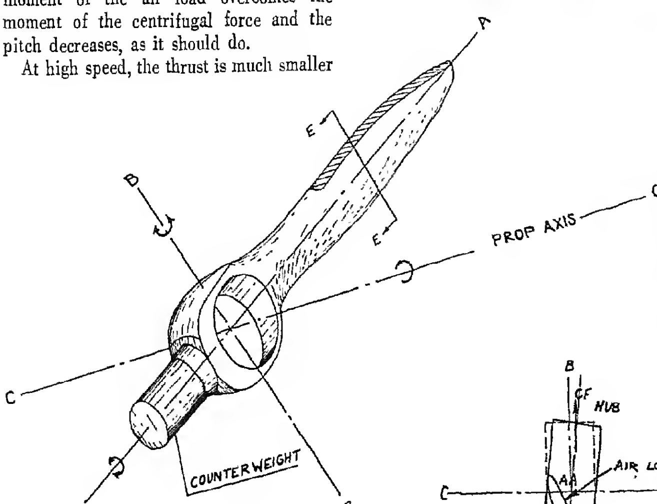
Thus the pilot is provided with an automatically adjustable propeller, which gives him the best efficiency without the bother of any gadgets to operate. As the pilot of even a small plane has many instruments and controls to think about, he will be thankful for a device which is purely automatic in action.—*A. K.*

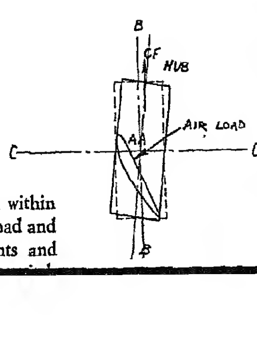
## Quick Starting in Cold Weather

IT takes time to warm up an aircraft engine sufficiently for a take-off to be permissible—particularly if the engine is water-cooled and the weather cold. For commercial flying, to some extent—for military aircraft decidedly so—it is important to be able to take off at the shortest notice no matter what the weather. There may be enemy aircraft to fight off, for example. In the engines built by the Bristol Aeroplane Corporation, a British company, a very simple device has removed all difficulties of cold-weather starting. When the engine



The single-blade variable-pitch propeller on a Fairchild cabin plane




***Above:*** **The single-blade propeller is free to pivot, within limits, about the axes AA and BB.** ***Right:*** **The air load and the centrifugal force introduce opposing moments and**

first fires, oil under high pressure is delivered to the bearings, and through a special oil by-pass an extra volume of oil is sprayed over the same bearings. As engine and oil warm up, the high-pressure system cuts out automatically and the special spray diminishes in intensity. The device is entirely automatic and needs no attention. Except for one additional external pipe line to the oil tank it adds nothing to the bulk or weight of the engine.—*A. K.*

## Light Cell Reflectometer

To fill a growing need for a practical instrument by which light-reflecting efficiencies of flat surfaces and light-transmission properties of transparent or translucent materials can be measured accurately, General Electric Company's incandescent lamp department has developed a device called the "G-E Light Cell Reflectometer."

As its name implies, this new instrument does its "seeing" with the same kind of photo-cell as that used in the familiar G-E Light Meter. Actually, the new Reflectometer employs two light-sensitive cells. These impart to a meter the relative amounts of light received by material under consideration and amounts redirected or transmitted thereby. A needle and meter scale are used to relay the desired information to the operator.

Heretofore, according to George Baumgartner, Nela Park engineer, under whose

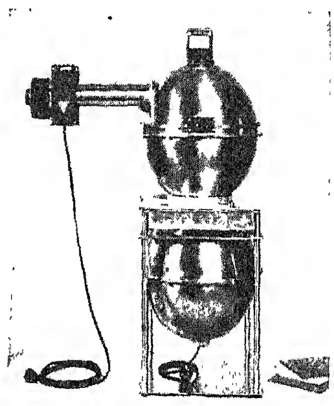
Determining the reflecting factor of a surface with the Reflectometer

supervision the instrument was designed and developed, most observers have had to depend on visual reflectometers, instruments requiring use of the trained human eye. Measurements thus obtained were found to be inaccurate for the most part, particularly when fatigue, caused by subjecting eyes to the strain of numerous observations, greatly increased the chance of error. With the new Reflectometer, however, both the expert and the novice can quickly determine true reflection and transmission values covering a wide range of materials.

The Reflectometer, a 10-inch hollow sphere of metal, is equipped with a movable tubular arm about a foot in length. The inner surface of the ball is painted flat white. The two light-sensitive cells are so embedded in the "equator" of the globe as to face each other. These cells are connected electrically to a micro-ammeter mounted atop the device. Held in the arm attachment is a small projection lamp and reflector by which a shaft of light may be directed into the sphere. The arm may be swung to such a position that the entering beam shines down through a circular opening, three inches in diameter, at the bottom of the globe.

To determine the reflection factor of a flat surface, the Reflectometer is set on or against the sample to be tested in such a way that the opening in the sphere is closed by the sample. The projection lamp is then turned on and a rheostat is adjusted until the needle of the meter rests exactly over the "100" mark on the scale.

Before the light is permitted to strike the



Measuring transparency or translucence by means of the Reflectometer

cells, it is thoroughly diffused by the matt finish of the sphere's inner surface. The operator next swings the arm into such a position that the beam of light falls at an angle of 30 degrees from the normal and directly upon the sample. Two small baffles prevent the reflected light from shining directly upon the cells. The true reflection factor of the surface being tested is registered on the meter scale.

In order to measure the transmission factors of various transparent and translucent materials the Reflectometer requires another sphere of similar size, also developed by Mr. Baumgartner.

## A Bridge that will Disappear

During the past summer a huge steel bridge was completed across the Columbia River at the site of the Grand Coulee dam project. It is a mammoth structure on which run the tracks for the constant procession of cement trains that carry the concrete for the dam from the mixing plants to the forms where the pouring is in process.

As great foundations rise, block by block, across the gorge of the Columbia, the steel supports for the bridge are gradually embedded in the concrete. As construction advances, the entire bridge will disappear and will be enclosed with the huge concrete structure's completion.

## New Pulp Bleach

Advantages over the customary process of bleaching mechanical wood pulp are claimed for the use of zinc hydrosulfite, which is being applied successfully in the production of news print paper on the Canadian Pacific coast. The new bleaching agent yields a product which permits the

use of a larger proportion of ground wood in mixed pulps for specialty papers and permits the use of unbleached sulfite pulp in mixtures with bleached ground wood on account of the better color of the latter. —*D. H. K.*

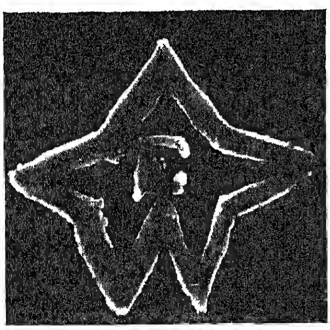
## Oriental Textiles

FOLLOWING a "gentlemen's agreement" between the United States and Japan, to limit Japan's sale of cotton textiles to the Philippines, there has been a startling increase in the Filipinos' purchases of textiles labelled "Made in Singapore," "Made in Hong Kong," "Made in China." On examination, much of this stock was found to be actually Japanese-made, complains a writer in *China Weekly Review.*

## Bacteria Which Produce Light

SOME forms of bacteria produce light, as is seen in the accompanying photograph. Fireflies over our lawns and luminous one-celled animals seen in the wakes of ships are more familiar but many other organisms including fishes, comb jellies, squids, shrimps, and fungi also produce a cold light of their own.

The bacteria in the photograph were spread on solid nutrient medium, making the form of a star with an E in the center, by the bacteriology class at Earlham College, Earlham, Indiana, according to Hurst Shoemaker, instructor in biology at that institution. After two days' growth in a dark room, the bacteria were distinctly visible by their own light. A camera was



Luminous bacteria

focused on them and in five hours they produced enough light to take their own photograph. The brighter edges are due to the fact that the actively growing and spreading ones give more light as one of the products of metabolism, while the older ones in the center are inactive.

Many species of such bacteria have been described and are most frequently seen in fish markets or on decaying fish along the ocean beach, causing the fish to glow at night with a phosphorescent light.

## Skin Cleanliness Best Treatment for Acne

FOR acne—the adolescent's complaint—local skin cleanliness brings the best results. That improperly functioning endocrine glands are probably responsible for acne, medical research workers believe. But no glandular substance found is enough better than local treatment to justify the

Thirty-nine students at the University of Iowa have recently been treated for acne as a part of a scientific experiment. Dr. Grace E. Williams, medical adviser to women, and Dr. Ruben Nomland, professor of dermatology at the university, report their observations on these students in the *Journal of the American Medical Association.*

With evidence pointing to a deficiency of sex hormone in acne patients, the Iowa physicians began their study. They took 28 women students and 11 men, the average age being 19 years. Of these, 11 had severe, 20 moderately severe, and eight mild acne.

All 39 students were asked to give meticulous attention to details in the care and treatment of their skin. In addition, 28 of them were treated with sex hormones, while the remaining 19 were also given injections but the injections were merely sterile water. The students did not know who were getting hormone substance and who were getting water.

Treatment went on for from four to six months with 85 percent of those given the hormone substance showing moderate to marked improvement and 78 percent of the control group given sterile water showing the same degree of improvement. The Iowa doctors concluded at the end of the experiment that a deficiency of the pituitary-like hormone is not an important factor in causing acne, and that the local treatment is still the best for controlling acne.

Here are the instructions for local treatment of acne given to most of the students: Stop all picking and squeezing. Discontinue the use of all cosmetic creams. Wash with soap and water twice daily, keeping the skin non-greasy almost to the point of scaling. Eat a diet low in carbohydrates. Eat no candy. Remove blackheads by placing hot towels on the face for five minutes, then applying a thin coating of 3 percent resorcinol in cold cream to the face and again applying hot towels for five minutes. The blackheads are then squeezed out with a comedone remover, the face rinsed with cold water and hamamelis water applied. Apply a prescribed lotion two or three times a day. Avoid iodized salt. Shampoo the hair twice a week.—*Science Service.*

## Tin Substitutes

CADMIUM, cadmium and copper, and copper alone are being studied in Germany as corrosion resistant coatings to replace tin.—*D. H. K.*

## Babylonian Math Sharks 2000 B.C.

BRIGHT people, the Babylonians. A math book written by Babylonians 2000 B.C. has just been deciphered, and scientists are deeply impressed by the amazing early progress of those ancients in higher mathematics.

The math book, written on 44 clay tablets, shows that 15 centuries before Greek math wizards were born, Babylonians were already doing many tricks with figures that Greeks have been credited with discovering. Babylonian mathematics included multiplication tables, a symbol for zero, negative numbers, tables for calculating areas and volumes, tables of squares and cubes and reciprocals.

book have lain un-read in Yale's Babylonian Collection. Now, Prof. O. Neugebauer, of the University of Copenhagen, has deciphered them, working from photographs and hand-made copies of the cuneiform inscriptions. The two missing "pages" of the book have been located in Paris.

Babylonians were more practical in their mathematical science than Greeks, the ancient book shows. Many of their tables would be useful in surveying and building, in digging dykes and constructing walls. But when it came to theoretical problems, the Babylonian math sharks understood quadratic and even higher degree equations and solved them by tables, as they are still solved.

The little old mathematics book, written in clay, clears up for mathematicians the puzzle of how the Greeks made such swift progress in this science.

"It seems now that a large body of facts must have been inherited by the Greeks from Babylonian sources," says Prof. Oystein Ore, Yale mathematician. "The exact manner in which this knowledge was transmitted is not yet altogether clear. The theorem of Pythagoras, for example, was well known to the Babylonians."

Hope that new excavations will bring new material to light was expressed by Prof. Ore, who predicts that the history of mathematics may be carried still further back into the past. So difficult are problems and solutions included in the Babylonian tablets, that Prof. Ore believes they must have been partly inherited from earlier times, perhaps from as far back as 2500 to 3000 B.C.—*Science Service.*

## Fever Treatment for Syphilis only Partially Successful

ARTIFICIAL fever treatment for syphilis, widely heralded when first developed, has not stood the test of time as well as the chemicals, arsphenamine and bismuth, Dr. Paul A. O'Leary of the Mayo Clinic, Rochester, Minnesota, recently told members of the American Medical Association.

Even those physicians who were most enthusiastic about machines for inducing fever to rout syphilis from the body, now recommend, as do those who use malaria to induce fever, the use of the arsphenamines and bismuth during or after the fever treatment in all types of syphilis.

Besides malaria and electric fever machines, typhoid vaccine and hot baths have been found helpful in treating some cases of syphilis. No one knows exactly why any of these methods is helpful. Dr. O'Leary himself believes that these treatments cause some fundamental change in the immunity or disease resistance of the body.

The infant death rate in families in which there is syphilis was 75 percent in the days before drugs were discovered that would cure the disease, Dr. Harold N. Cole of Cleveland reported. It is probably from 20 to 30 percent even now.

Babies can be protected from this disease if their mothers are given anti-syphilitic treatment during the months before the birth of the child. If the mothers are not treated, the child of syphilitic parents will either die or within a few weeks after birth show signs of the disease including the "senile, little old man appearance" characteristic of syphilis in infants. These babies are not [illegible] less, cry feebly, and often have a reddish brown skin eruption. Bones may become involved and the child may act as if paralyzed. Teeth, bones, joints, brain and nervous system, eyesight and hearing may all be affected by congenital syphilis.—*Science Service.*

## Non-Poisonous Illuminating Gas

NUMEROUS processes have been suggested for making illuminating gas safe. Lately success has been attained with a method of converting the carbon monoxide in the gas to carbon dioxide and hydrogen by the action of steam in the presence of a contact mass. In this way the heating value of the gas is improved since the carbon dioxide formed in the treatment is removed. The contact mass consists of a mineral ankerite, a natural carbonate of iron, calcium, and magnesium, or it may be a synthetic mixture of these materials. This contact mass is used over and over by regenerating it after each use by heating in a furnace.

Numerous other methods have been suggested from time to time to remove carbon monoxide from gas or to warn of its presence. The method described is reported in use in Germany.—*D. H. K.*

## Plant Fossils in the Making

FOSSILS were not all made and stored in the rocks millions of years ago. The first steps in the making of plant fossils have been seen and reported to the Carnegie Institution of Washington by one of its research associates, Dr. Ralph W. Chaney, chairman of the department of paleontology at the University of California.

When the great triple-peaked volcano Katmai in Alaska blew up in 1912, hurling some five cubic miles of ash into the air, part of the finely powdered material settled like snow on the branches of evergreen trees, pulled off billions of their needles, and bore them down to the ground.

Now, a quarter-century after the great eruption, Dr. Chaney has revisited the region and dug down to the bottom of the foot-deep ash. There he found the tree leaves pressed down in a matted layer, mostly in the lower few inches. They looked for all the world like the matted fossilized leaves he has often investigated in the ancient geological deposits in Oregon known as the John Day formation, which were volcano-formed many millions of years ago. [Source of many important mammalian fossils.—*Ed.*]

Of course the single Katmai eruption layer had only a small fraction of the thickness of the John Day formation. Many more eruptions, covering many centuries, would be needed before the Alaska situation would resemble the Oregon beds. But the basic principle is the same; and one man has seen, well within the limits of his working lifetime, the beginnings of a true process of fossilization.—*Science Service.*

## Deflating the Inch

A BILL, phrased in "millionths" instead of millions, has recently been submitted to the Secretary of Commerce for transmission to Congress, dealing with pro-

weights and measures in the United States. It seems strange, 150 years after the founding of the Republic, that legislative action should be necessary to fix the value of the inch and the pound with which we are so familiar. Nevertheless, the fact is that we have never had a statute which defines the way in which these units shall be determined. The National Bureau of Standards is now advocating a minor legislative change to bring the defined value of the inch "into line."

The proposal now calls for the establishment of the United States inch as equal to exactly 25.4 millimeters. The British inch, derived directly from the Imperial yard, is about four parts in a million shorter than the United States inch. The proposed legislation inch falls midway between present values of the British and United States inches.

This reduction of only two parts in a million of the inch will therefore not affect industry, because it falls within the tolerances employed in industrial measurement. Recently the conversion factor, 25.4 millimeters per inch, was adopted for industrial purposes by standardizing groups in 15 countries including the United States and Great Britain.

Only in the most precise measurements of length, as in the making and certifying of precision gage blocks and line standards of length, would this proposed change be of any significance. In fine micrometer screws, lead-screws of lathes, or other industrial equipment, it would not be significant. On the other hand, it puts on a definite basis the status of the fundamental unit of length, and therefore of both area and volume. Furthermore, it specifies exactly how this length shall be measured in terms of one of the immutable spectroscopic standards of length now used, the wavelength of the strong red line in the spectrum of cadmium.—*Industrial Bulletin* of Arthur D. Little, Inc.

### TAXES

**NEARLY 16 cents out of every dollar of State taxes paid by highway users in 1936 was assigned to non-highway use. Allocations to non-highway purposes amounted to 169,344,000 dollars, an increase of 22,202,000 dollars over the previous year.**

## Death From Old Age Rare Among Even Wild Animals

FEW wild animals die of old age, in spite of their freedom from the ills of civilization. Food shortage, accidental injuries, diseases, and natural enemies are the principal causes of death in the wild, says the United States Biological Survey.

Pneumonia, or inflammation of the lungs, is one of the common causes of death in the wild, as well as in civilization. Starvation is one of the most important contributing causes.

A number of wildlife diseases also attack human beings with serious and sometimes fatal consequences, and investigators must always be on guard in examining sick or dead animals. Rubber gloves and antiseptics are essential, and also care against bites by ticks and fleas from the animal. Rabies, anthrax, bubonic plague, glanders, tularemia, and undulant fever are among the wildlife diseases that man must guard himself against.

## Abandoned Coal Mines Are Sealed

THE sealing of abandoned coal mines in the hills and mountains that form the watershed of the Ohio River and its tributaries is cutting the estimated annual 10,000,000-dollar loss which they create.

How an abandoned mine that no one uses can create this loss is, at first sight, obscure, but the answer is the 3,000,000 tons of corrosive sulfuric acid which these mines pour into the Ohio River each year.

Abandoned coal mines, pointed out Prof. W. W. Hodge of West Virginia University, may have much rock containing sulfur. When ground water seeps into the mine and oxygen from the air is present, the sulfur, hydrogen, and oxygen combine to form *sulfuric acid. This acid is carried away by the* natural mine drainage until it eventually reaches the rivers. The increased acidity attacks metal surfaces of boats, bridges, and other things and creates the estimated damage.

Sealing some 47,000 mine openings in 13,500 mines has done much to divert surface water, decrease the oxygen content of these mines, and reduce the formation of the corrosive acid. Federal funds have made possible this project, which has already improved streams in the Ohio Valley.

*—Science Service.*

## Japan to Synthesize Camphor?

JAPAN'S monopoly of camphor and the price control which it exercises has encouraged the United States and Germany to synthesize camphor for themselves. Now word comes from Japan of the formation of a company to synthesize camphor in Manchuria by the processes used in Germany. The manufacture of synthetic camphor is prohibited in Japan itself as a protection to the industry in Formosa.—*D. H. K.*

## Africa Once Covered With Forests

AFRICA was once a vast forest-covered continent and the present great deserts of Sahara and Kalahari are the result of a "drying up" of that part of the world. This is the conclusion of Dr. Herbert Friedmann, Smithsonian Institution curator of birds, after an exhaustive study of bird specimens from Ethiopia and Kenya Colony.

There was a vast and rapid exodus of bird life from the steppes of Asia to the then newly created African grass lands, Dr. Friedmann explained. Present day life of the east African plains is very similar to that which flourished in central and south central Asia during the Pliocene geological era before the great Ice Ages.

The ostrich and other birds, such as the vultures, marabou stork, larks, cranes, and so on, were originally Asiatic and came into Africa when the great forests disappeared. The present dense jungles of Africa are survivals of the primeval wilderness.—*Science Service.*

# CURRENT BULLETIN BRIEFS

*(Bulletins listed as being obtainable through Scientific American can be supplied only by mail)*

ROUND THE WORLD FOR BIRTH CONTROL, with Margaret Sanger and Edith How-Martyn, is an account of the visit of these two noted leaders to Europe and especially the Far East, in the interests of birth control organization. *Birth Control Clinical Research Bureau, 17 West 16th St., New York, N. Y.—25 cents.*

CAST CAMSHAFTS AND CRANKSHAFTS POSSESS MANY ADVANTAGES, by Fred J. Walls, is reprinted from *The Foundry.* This 8-page pamphlet puts forth the advantages of casting these particular machine parts, and presents the case particularly in view of the old conception of cast iron as an unreliable and brittle metal. Illustrated with drawings and photographs, and accompanied by comprehensive tables. *Write for Bulletin 1137A, Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

THE AIRSHIP, the world's only airship journal, is published quarterly in London, and is now available for subscription in foreign countries. *The Airship, Wm. Dawson & Sons, Ltd., Cannon House, Pilgrim Street, London, E. C. 4, England.—Subscription price $1.50 per year.*

LAFAYETTE RADIOS AND SOUND SYSTEMS is a thoroughly illustrated catalog of 176 pages, with a complete index, which lists all types of radio receivers from the smallest to the largest, parts for replacement and repair, vacuum tubes, sound system equipment, and many types of electrical supplies. *Write for Bulletin 1137B, Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

METHODS OF MAKING THREE-COLOR SEPARATION NEGATIVES is a small booklet that will be invaluable to the serious-minded amateur photographer and to the professional. *Defender Photo Supply Company, Inc., Rochester, New York.—10 cents postpaid. Free to photographers on business letterhead request.*

PIPE REPAIR HANDBOOK. Engineers, superintendents, and maintenance men responsible for pipe line maintenance will be interested in this booklet. It discusses all the various kinds of leaks in pipe lines—holes, splits, pitted or corroded sections; joints of various kinds, such as threaded joints, bell and spigot joints, welded joints, collars, and so on; and discloses how repairs may be made without service interruption. The Handbook is furnished without cost to men responsible for pipe maintenance. *M. B. Skinner Company, South Bend, Indiana.*

BORROWING MONEY is a 22-page pamphlet that will be of particular value to the individual and the small business man. It lays particular stress on the fact that it is no disgrace to borrow money although it is unwise to do so unless it is absolutely necessary. This pamphlet has been prepared to help in just such emergencies. It tells where to go to borrow money, how such loans are secured, and particularly warns against doing business with illegal lenders. The text is straightforward and business-like and does not beat about the bush. *National Better Business Bureau, Inc., Chrysler Building, New York City.—Gratis.*

HANDY CIRCUIT-BREAKER DATA is an 8-page illustrated folder which deals particularly with the electrical circuit protection afforded by a new fully-magnetic, non-thermal circuit breaker, available in instantaneous-trip and time-delay actions. *Write for Bulletin 1137C, Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

DRAUCKER PHOTO FLASH CALCULATOR is a small pocket-sized "slide-rule" with which the amateur photographer can determine the type and number of Photoflash lamps to be used for a certain job and the diaphragm openings for synchronized or manual operation of the flash. The device is ruggedly made of celluloid and cardboard. *Munder Electrical Company, Springfield, Massachusetts.—50 cents.*

LOCATION OF FORD MODEL V-8 POWER PLANT TROUBLES MADE EASY, arranged by Victor W. Pagé, M.S.A.E., is a folded chart 22 by 34 inches which illustrates the vital parts of the V-8 motors. It lists the various troubles that may be encountered and gives hints as to how to rectify them. *The Norman W. Henley Publishing Co., 2 West 45th Street, New York City.—35 cents.*

INDUSTRIAL HANDBOOK TO GREAT BRITAIN has been compiled to give preliminary information to manufacturers who are considering the establishment of factories in Great Britain. It tells briefly of facilities available—finance, transportation, insurance, labor conditions and regulations, tariffs, taxation, and so on. *The Travel & Industrial Development Association of Great Britain & Ireland, 620 Fifth Avenue, New York City.—Gratis.*

## SCIENCE TURNS TO SHAVING

(*Continued from page 264*)

the waterproof oil that is secreted by the sebaceous glands. The presence of this oil delays the penetration of the water into the hair, and for quickest results it must be removed. It varies in composition with dietary changes. When one's normal lathering process is deficient, this variation may account in part for the observation that shaving is easier on some days than on others. Soap suds or lather (containing over 98 percent water) is, of course, the most universally used detergent, but in the special case of these sebaceous oils the active constituents of brushless shaving creams are

(*Please turn to page 316*)

# LEGAL HIGH-LIGHTS

## Patent, Trade Mark, and Related Legal Proceedings That May Have a Direct Effect on Your Business

By ORSON D. MUNN, Litt.B., LL.B., Sc.D.
New York Bar
Editor, Scientific American

### WITHOUT LICENSE

IN a recent suit between two prominent radio manufacturers for infringement of patents on a radio circuit, the defendant contended, among other things, that he obtained a license to manufacture and sell the patented circuit by purchasing radio tubes for the circuit from a licensee of the plaintiff. The Court found that the defendant was manufacturing radio sets embodying the patented circuit. Defendant purchased in the open market radio tubes which were manufactured by a licensee of the plaintiff. The radio tubes were primarily designed and suited for use in the patented circuit and the defendant claimed that the purchase of licensed radio tubes of this character carried with it a license to manufacture the patented circuit. The Court rejected this contention, however, because it found that the tubes were suited for other uses, and that, furthermore, they were accompanied by a notice restricting the use of the tubes to replacements in apparatus licensed under the patents in suit.

Another interesting defense was involved in the suit. It appeared that each of the patents was drawn to a combination which included the radio tubes in the circuit. The defendant placed tubes in the sockets of the infringing sets, for the purpose of testing the sets. Prior to selling the radio sets, the tubes were removed from the sockets and they were packed separately in the receiver cabinets of the sets at the time of sale. It was contended by the defendant that since the patents included the tubes in the combination, the sale of the sets without the tubes in the sockets did not constitute infringement. The Court disagreed with the defendant, however, and held that there was infringement, stating:

"Where the elements of an infringement are thus sold in substantially unified and combined form, infringement may not be avoided by a separation or division of parts which leaves to the purchaser a simple task of integration."

### INTERSTATE PRICE FIXING

THE Miller-Tydings Act which was passed during the last session of Congress permits the fixing of resale prices, by contract, in interstate transactions where the commodity bears the trade mark, brand, or name of the producer or distributor of the commodity, and where the resale is to take place in a state permitting such contracts. Most of the states of the Union have enacted so-called fair trade statutes, validating contracts prescribing the resale prices of trademarked merchandise. On this page in the February, 1937, issue of Scientific American, under the heading of "Price Fixing," we pointed out that while the state fair trade statutes permitted resale price maintenance on trademarked goods in intra-state transactions, the Sherman Anti-Trust Law still prevented price maintenance in interstate transactions.

The purpose of the Miller-Tydings Act was to remove this conflict between state and federal law and to permit contracts in interstate sales for maintaining the resale prices on trademarked commodities in states having fair trade statutes. This is a further example of the growing importance of trade marks, which we have referred to from time to time on this page.

### RADIOACTIVITY

CAN a hotel receive copyrighted music from a licensed radio broadcasting station on a master receiving set and then transmit it to loudspeakers in the various bedrooms of the hotel without license from the copyright owner? Under a recent decision of a Federal District Court, the hotel would be guilty of copyright infringement.

In this decision the Court found that a large New York hotel was equipped with two master receiving sets which were connected by wires to loudspeakers in each of the bedrooms of the hotel. The master receiving sets were tuned to different stations and each loudspeaker was equipped with a switch whereby the guests could select the program being received on either of the two master receiving sets. One of the master receiving sets of the hotel was tuned to a station which was broadcasting a song copyrighted by the plaintiff in the suit. The broadcasting company was licensed by the plaintiff to broadcast the song, but was specifically forbidden under the license to grant licenses to anyone else. The copyrighted song was duly received on one of the master receiving sets of the hotel, and a guest by turning the switch on the loudspeaker in his room to the proper position would receive the copyrighted song. The plaintiff contended that the action of the hotel in receiving the copyrighted song on the master receiving set and making it available to the guests through the medium of loudspeakers in the several bedrooms amounted to copyright infringement.

The United States Copyright Act provides among other things that the proprietor of a copyright shall have the exclusive right "to perform the copyrighted work *publicly for profit* ******." The owner of the hotel contended that they did not publicly perform the copyrighted song for profit and accordingly they were not guilty of copyright infringement. The Court disagreed with this contention, and found the hotel owners guilty of copyright infringement, stating:

"The guest personnel of a hotel******, although it shifts constantly, always constitutes a small cross section of the public. Clearly broadcasting within the hotel walls to the cross section of the public***must be as much a public performance as would be broadcasting in theaters."

On the question of profit for the performance, the Court stated:

"That inter-mural broadcasting by the hotel is not only a public performance, but also a performance for profit is obvious because it is one of the considerations given to the guests of the hotel for the rental of its rooms."

### GRADE MARK

A GRADE mark, as distinguished from a trade mark, cannot be registered in the United States Patent Office. In an interference proceeding recently decided by the United States Court of Customs and Patent Appeals two applicants were seeking to register the trade mark "Buckeye" for gloves. The Court found that the prior user of the word "Buckeye" on gloves was not entitled to register the name because he had used the word as a grade mark rather than a trade mark. The trade mark of the prior user was "Co-Shoc" and this was rather prominently displayed on the glove. In addition to the trade mark, the word "Buckeye" appeared on one type of glove and on other types of gloves different words were associated with the trade mark. The Court held that this use of the word "Buckeye" indicated a type or grade of glove and was not a trade mark entitled to registration under the Federal Trademark Statute.

It is interesting to note that the Court also refused to permit the later user of the word "Buckeye" to register the word as a trade mark, on the grounds that the later user was not entitled to exclusively appropriate the mark in view of the prior use of the word as a grade mark. In this connection the Court stated:

"It is our view that, under the facts developed here, neither party has shown itself entitled to claim ownership and, therefore, exclusive use of the mark. Appellant did not own the mark at the time of filing its application because it had not used it as a technical trade mark. This it did not attempt to do prior to the date claimed by appellee. On the other hand, appellee, at the time it claims to have adopted the mark, had no right to appropriate it to its exclusive use because of appellant's prior use of it to indicate a grade, or model, of its merchandise."

### ARTLESS

IN a recent suit between two prominent paper cup manufacturers, it was decided by the court that a paper drinking cup cannot be classified with the fine arts. The plaintiff had obtained a copyright on a pictorial illustration which it used in association with its drinking cups, and charged that the defendant used an illustration which infringed its copyright. The plaintiff's copyright was registered under a Section of the Copyright Law providing for registration of copyrights for pictorial illustrations connected with the fine arts. The court held the copyright registration invalid for the reason that a paper drinking cup was a commercial article and accordingly the illustration was not for use in connection with the fine arts.

## SCIENCE TURNS TO SHAVING

(*Continued from page* 314)

also effective (most of them contain 65 to 75 percent water). These creams are often slightly acid in character, and there is a probability that razor-blade service is shortened thereby. The mixing of a little soap lather with such preparations definitely overcomes any possible objection on the grounds of acidity.

Even when vigorous rubbing and hot water are used for lathering, 85 percent progress toward complete softening of the hair is not attained in less than two minutes. In the case of men having grey or white hairs in their beards, this minimum time may be extended to five minutes, because white hair is more resistant to softening than naturally colored hair. The value of a shaving brush lies in its capacity to carry a bulk of hot water that does not cool off quickly, rather than its ability to work up unnecessarily deep lathers. The value of shaving soaps lies to some extent in their appeal to the habit of shaving with deep lathers, but more particularly their freedom from excess alkali and in the slow-drying quality of their lathers. Shaving soaps are probably the purest soaps made for any purpose. It is definitely good practice to wash and rinse the face at least once, preferably twice, with hot water and good toilet soap before applying the lather or a brushless cream. The idea is partly to consume time toward the two-minute softening period, and partly to remove gritty accumulations from the face.

These gritty materials are often harder than razor steel. It is asking too much of the razor maker to expect blades that will resist the ruinous effects of hard grit. These washing operations are frequently omitted by many men, and what a lot of "soft blades" they do find!

Then one's favorite shaving preparation may be applied, still using hot water. If his preference is based on a taste for the perfume in it, that is quite all right. Shaving may be begun at the end of two to five minutes, depending on the diameter and spacing of his hair shafts.

THERE is no known short-cut to this process. Where one's skin is unusually tender, cold water may be used for the final lathering, but in this case the lathering time should be extended to five minutes.

Adequate and effective softening of the hair mitigates both the pulling sensation and skin removal. The skin excisions are more conspicuous in the case of men having coarse, densely distributed hairs than in others, and in every man in those areas at the front collar line where the hair grows out nearly flat with the skin. Individuals differ by more than 4 to 1 in the amount of skin and hair removed by each daily shave; they differ by over 8 to 1 in their capacity to dull razor edges during shaving. One of the features of this variation that does not amuse razor makers is the failure of men at the two extremes of this range to understand each other's shaving problems or to discount properly the other men's shaving experiences. Nearly every man thinks he has about the toughest beard and tenderest skin in his community.

When shaving is carried out with a properly softened beard, and by use of a razor having a sufficiently small tangent angle, skin irritation is at a minimum and there is little need for after-shaving lotions. There are exceptions, of course, in the case of men with unusually coarse, dense beards, particularly when they attempt a very close shave. A shaving lotion does no harm in any case. It should have astringent as well as antiseptic properties. A 50 percent to 70 percent solution of ethyl alcohol is a good example of an agent having such properties. Many commercial lotions consist principally of this reagent; "rubbing alcohol" is a cheaper but less appealing form. The soap should be completely rinsed from the face before using any alcoholic lotion.

Soap makers are progressing in making available soaps and creams that are non-irritating to the skin. One after another, constituents of soaps to which skins may be sensitive or allergic are being eliminated. The present soaps are among the best antiseptic materials for the skin; yet soap technologists may some day produce soaps that are strong disinfectants for every pathogenic organism. Progress has also been remarkable in providing soaps that do not dry out on the face—an important item in dry climates. Shaving-soap makers fail to warn the user, however, that his success in working up a creamy lather on the face does not indicate complete softening of the beard. The presence of a thick lather in no way eliminates the necessity for using time for beard softening; it indicates that hair softening has only just begun, not that softening is complete.

IT is also true that the safety razor and its replaceable blade represent a definite advance in personal hygiene, which will be unquestioned as soon as users learn how to treat their faces properly. The current stage of progress in the razor field itself seems to be one where most manufacturers are taking the best of the razor steels and trying to make them ever sharper and ever more uniform. Some of them have had considerable success according to the writer's measurements. Their success in making uniformly sharp, durable blades is demonstrably greater than that of the user in softening his beard. Science is called upon freely, not only in devising control and inspection instruments for razor factories, but in the collateral fields of metallurgy and abrasive sharpening materials. In the latter field alone the progress has been such as to make quantity production of blades better and cheaper. Here and there a razor manufacturer is using scientific methods to study the newer alloy steels, with results that promise a more durable product than was ever available to the barbers of old.

Suggestions are occasionally made to use as razor materials some of the newer compounds that are harder than steel, such as tungsten carbide, other carbides, nitrided steel, and even glass. To produce a sharp, nick-free edge on such materials is a problem of such magnitude that its advantages might never compensate from an economic viewpoint for the expense involved. Furthermore, the necessity for correct facial treatment, like poverty, will always be with us. It is a safe prediction nevertheless that progress will be made in definite ways by razor makers now in the field who are energetically studying their subject in broad scientific ways.

# Books SELECTED BY THE EDITORS

## THE WORLD AND MAN AS SCIENCE SEES THEM

*Edited by F. R. Moulton, Ph.D., Sc.D.*

A POPULAR and most readable, large, 535-page symposium on the physiological and biological sciences, edited by a noted astronomer and contributed to by Moulton (astronomy), Chamberlin (geology), Lemon (particles and waves), Schlesinger (chemistry), Newman (nature and origin of life), Coulter (plants), Allee (evolution), Romer (vertebrates), Carlson (physiology), Taliaferro (microbes), Cole (man). Each chapter covers its field in a broad survey. This is likely to prove to be one of the year's best scientific books. It is more informative than the majority of the surveys of the worlds of matter and life that are so frequently published.—$3.20 postpaid. —*A. G. I.*

## HANDBOOK OF CHEMISTRY

*Edited by Norbert Adolph Lange, Ph.D.*

EVERY worker in chemistry must as a first necessity have close at hand for ready reference a compendium of information in convenient form. In the selection of such a *vade mecum* for his personal use, the individual is guided by his own views as to the breadth of information contained in the volume, the degree of accuracy of the compilation, and the ease with which desired facts can be found. Lange's Handbook meets these criteria to a very satisfactory degree. The range of facts covered is extremely broad, the present second edition has benefited from the correction of inescapable errors in the first edition, and the arrangement of tables copiously cross-indexed is logical and convenient. A very useful volume of chemical, physical, and mathematical data.—$6.25 postpaid.—*D. H. K.*

## COMPLETE GUIDE TO HANDLOADING

*By Philip B. Sharpe*

WHAT ballistics expert, sharpshooter, or big game hunter would not sit into the wee small hours of the morning poring over this study of rifles and ammunition? Whether such gun enthusiasts "load their own" or not, the data in this huge volume will tell them much they did not know about their arms and ammunition; if they do not already do they will start immediately after reading this book. It is mightily intriguing even to a layman editor who seldom gets the chance to fire an arm of any kind. Practically everything the rifle and pistol shooter will want to know is included. Many illustrations.—$7.25 postpaid.—*F. D. M.*

## MAKING AMATEUR PHOTOGRAPHY PAY

*By A. J. Ezickson*

IF you would make money with your camera there are certain fundamentals that you must learn about the profession of free-lance photography. And there is no better source of information than a man who has made a living with his camera. Such a man is the author of this book; he has been through the mill and knows what it takes to get a picture that will appeal to hard-boiled editors of newspapers and magazines, as well as others who buy photographs for specific purposes. Some interesting examples are given of famous news pictures that have won worldwide recognition.—$1.15 postpaid—*A. P. P.*

## MATTHEW BOULTON

*By H. W. Dickinson*

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*By Evan J. David*

OF all adventurous professions, that of the Coast Guardsman is probably more replete with thrills and danger during times of peace than any other one of comparable size. This particular volume tells the story of the Coast Guard not in cut and dried fashion but by the telling of many dramatic stories of its operations. We agree with the publisher's description that "Here is an exciting and inspiring book, with the tang of the sea in it and the dramatic quality of high adventure on every page." 298 pages, illustrated.—$2.15 postpaid.—*F. D. M.*

## ABC OF AGROBIOLOGY

*By O. W. Willcox, Ph.D.*

A TREATISE on plant culture as an exact science in the sense that the laws of nutrition and quantitative growth of plants can be stated and used scientifically. The end results can almost be guaranteed. Soil fertility and soil science form a large part of the subject matter. $2.90 postpaid.—*A. G. I.*

## CHILDBIRTH YESTERDAY AND TODAY

*By A. J. Rongy, M.D.*

AN illustrated story of childbirth among primitive people, in early civilizations, in the early age of science, in the age of science, in the days of ignorant midwives, and today. There is a chapter on the history of child care, also an amusing chapter on ancient ways of making the father help (?) instead of getting under foot during child-

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maternal mortality. Not intended to be a practical book, it entertains and provides historical background, and plainly shows what a ghastly world this used to be for women.—$2.15 postpaid.—*A. G. I.*

## STEEL SQUARE POCKET BOOK

*By Dwight L. Stoddard*

THERE is a great deal more to the use of the carpenter's steel square than is apparent on the surface. This little book shows how it may be used for laying out various kinds of figures, to determine different pitches and degrees, to solve problems of common rafters, hipped roofs, octagonal, hexagonal, and circular roofs. In fact, the steel square can be used just as well for laying out a star or building a bicycle track as for determining the line for a square cut on the end of a timber.—$1.10 postpaid.—*F. D. M.*

## SUPERIOR CHILDREN

*By John Edward Bentley, Prof. Education and Psychology, American University.*

A STUDY of the physiological, psychological, and social development of superior children, dealing with the aims and objectives of their education, their physical, mental, social, and moral qualities, abilities and talents; also with precocity, the gifted girl, discovery and diagnosis of superior children, their education and their teachers. A rather technical book and a bit pedantic.—$3.15 postpaid.—*A. G. I.*

## ALL THE WORLD'S FIGHTING FLEETS

*By Pay-Lieut. Commander E. C. Talbot-Booth, R.N.R.*

CHUNKY in build, this little volume of nearly 700 pages gives the details of world navies with pictures of many of the ships discussed. Other data include drawings of ratings insignia, photographs in color of service bars, decorations, and signalling codes both by telegraph and flags. Much of the discussion has a British flavor but the book as a whole makes a splendid reference book on the relative strength of navies of the world.—$3.20 postpaid.—*F. D. M.*

## PHOTOGRAPHY BY ARTIFICIAL LIGHT

*By Marcel Natkin*

COVERING photography at home, in the street, and at the theater, this compact book of 80 pages, plus an exposure table, gives meaty data for the amateur photographer. It not only tells how to use controlled lighting in the home, but also shows the varying results obtained with only minor changes in the positions of the lighting units. In discussing street and theatrical photography, it tells how to get the best results with any particular camera, and how to take the greatest advantage of the lighting available. The photographs used to illustrate the text are alone worth the price of the book.—$1.35 postpaid.—*A. P. P.*

## ORIGINS OF CLERK MAXWELL'S ELECTRIC IDEAS

*Edited by Sir Joseph Larmor*

THESE letters run from 1854-1879. They present a sharp and crisp account of the genesis and rapid progress of Clerk Maxwell's ideas as he groped towards a structural theory of the electric and magnetic field. They form, in fact, an informal study in the natural mentality of a man of proved genius. Rather technical and mathematical.—$1.15 postpaid.—*A. G. I.*

## SENTINEL OF THE COASTS

*By George R. Putnam*

SINCE this is "The Log of a Lighthouse Engineer" it gets down to brass tacks in telling an authentic story which has never before been told. That story concerns itself with every detail about lighthouses from their construction and maintenance to the study of the men themselves who live with them and often in them, isolated from their fellowmen. It is popularly written for laymen, as may be noted by some of the chapter headings: The River; The Devil's Thumb; To Greenland with Peary; Stars and Maps and the Floating Crust; The Government Set-up; Lighthouses—Two Thousand Years; Romance of the Buoys; Behind the Lights; and others in a similar vein.—$3.65 postpaid.—*F. D. M.*

## THE BIOLOGY OF HUMAN CONFLICT

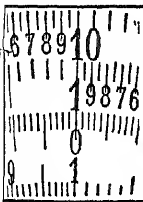
*By Trigant Burrow, M.D., Ph.D.*

AN interpretation of the origin of behavior disorders, dealing with organismic psychology and morphology, and with phylopathology. This book is not recommended to readers who lack good grounding in the literature of psychology, as it is wordy and difficult to bring into mental focus.—$3.65 postpaid.—*A. G. I.*

## FAMOUS LINERS AND THEIR STORIES

*By Alan L. Cary*

PRIMARILY British in conception and design, this volume discusses also a few vessels flying the flags of other nations. It gives some of the history of each and all the details—dimensions, tonnages, number of passengers carried, kind of engines, and so forth. An intro-







duction discusses the building of liners in chronological order to show improvements of various kinds. A long chapter at the end gives the history of some famous British shipping lines. A picture and a silhouette are given for each of the 62 liners discussed, with but few exceptions.—$2.65 postpaid.—*F. D. M.*

## AN ELEMENTARY SURVEY OF MODERN PHYSICS

*By Gordon F. Hull, Prof. of Physics, Dartmouth College*

A STRAIGHT textbook which endeavors to cover the newer physics with a minimum of mathematics and in clear, direct terms. Typical chapters cover molecules, electrons, radiation, photoelectric effect, atomic spectra, X rays, electron tubes, Zeeman and Raman effects, radioactivity, transmutation, cosmic rays, waves and particles, uncertainty principle, and so on. To permit mathematical difficulties (none of them worse than a little algebra) to be surmounted, the work of Heisenberg and Dirac had to be omitted. This book is a successful attempt to let the ordinary student in on some—at least—of the "deep stuff" without swamping him. The fact is, such a book brings the reader closer to the actual realities than the numerous popular books, which are one remove from these same realities, and it does it more briefly and concisely. Even in a text book the author shows he is a human being, with a sense of humor. —$3.70 postpaid.—*A. G. I.*

## THE HANDY MAN'S HANDBOOK

*By C. T. Schaefer*

THIS fourth edition of a very popular book is now available at a new low price. It is essentially a practical manual which tells how to use simple tools, how to do odd jobs around the home or shop, and also how to renovate and repair ordinary household equipment and furniture. It covers not only carpentry, but also plumbing, electric wiring, and a miscellany of jobs. 274 pages, well illustrated with an appendix of formulas, tables, and general mechanical hints. —$1.15 postpaid.—*A. P. P.*

## RADIO CITY STAR AND CONSTELLATION FINDER

*By James S. Andrews, Official Astronomer—Observation Roofs, Radio City*

NOT a book but a cardboard, printed, rotating device which automatically shows the stars as seen at any hour in the year. A help in learning the constellations. Similar devices have long been common but were rather expensive, possibly in part because the dials were coated with luminous radium salts. The present device is not radium coated.—85 cents postpaid.—*A. G. I.*

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NINETY-THIRD YEAR • ORSON D. MUNN, Editor

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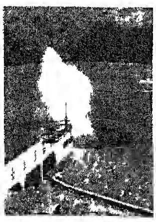


THIS month's front cover, reproduced by courtesy of the Bureau of Reclamation, United States Department of the Interior, shows water pouring into the Owyhee Dam spillway at the Owyhee project, Oregon-Idaho. The rising spray is caused by the updraft of air from the huge spillway opening.

## INDEX TO VOLUME 157

A COMPREHENSIVE index, carefully cross-referenced, for issues of Scientific American from July to December 1937 inclusive, is available in the form of a four-page pamphlet identical in size with the magazine. Copies of this index, suitable for filing or binding, may be obtained by addressing the Editor and enclosing a three-cent stamp.

## The SCIENTIFIC AMERICAN DIGEST



SCIENTIFIC AMERICAN, December, 1937. Vol. No. 157, No. 6, entered at the New York, N. Y. Post Office as second class matter June 28, 1879, under the act of March 3rd, 1879; additional entry at Greenwich, Conn. Published monthly by Munn & Company, Inc., 24 West 40th Street, New York City.  Subscription price $4.00 per year. Canada $4.50. Foreign $5.00. Manuscripts are submitted at the author's risk and cannot be returned unless accompanied by postage.

18-12-37

# 50 Years Ago in . . .

SCIENTIFIC AMERICAN

*(Condensed From Issues of December, 1887)*

CANAL—"The proposal made by M. De Lesseps in his letter to Premier Rouvier will not fail to interest those who have followed the progress of his scheme for an interocean canal at Panama. After an expenditure of nearly three times the sum originally estimated by him as sufficient to build a surface level canal, he now asks the French government to authorize him to raise $113,000,000 additional by a public lottery, to enable him to construct a lifting lock canal. It would seem from this that unless the French people subscribe a sum which, with what has been expended, will raise the cost of the canal to the extraordinary total of nearly $500,-000,000, the project of a canal at Panama must be abandoned."

FOR CELLAR FIRES—"The Paulin cellar-fire apparatus (used by the Paris fire department) consists of a suit like that used by divers, which allows a fireman to enter a cellar in which the air has been rendered irrespirable by a conflagration. . . . The fireproof suit consists of a leather blouse, fastened at the waist and wrists with ligatures, and provided with a hood and iron mask. The air necessary for respiration is introduced through an aperture in the back of the suit, by means of a rubber tube of great length. The blouse is very roomy, and allows great liberty of motion."

FROGS—"Almost all the frogs used for experiments in vivisection in the European universities are supplied by an old fisherman of Kopenich, who, for forty-five years past, has devoted himself to this pursuit. Sometimes he has succeeded in catching as many as a thousand in one night." (*Sic.*)

SALT—"In the Colorado desert, near Idaho, there is a large bed of rock salt, and the Southern Pacific Railroad, in laying the track to the salt bed, has been obliged to grade the road for 1,200 feet with blocks of these crystals. This is the only instance where a road-bed is laid and ballasted on salt."

NITRO-GLYCERINE SHELLS—"At Sandy Hook, recently, Serge D. Smolianinoff made experiments in firing nitro-glycerine from a 100 pound Parrot rifled gun, using eighteen pounds of service powder for a shot. The shells used were of about ninety-two pounds weight, and were charged with five pounds of nitro-glycerine each, and provided with the inventor's igniter. . . . Only three shots were made, further experiments being prevented by darkness. . . . With these three shots Mr. Smolianinoff has to his credit 327 shots, all of which are said to have been successful."

POWER—"Four-fifths of the engines now working in the world have been constructed during the last 25 years. . . . The steam engines of the world represent approximately the work of 1,000,000,000 men, or more than double the working population of the earth, whose total population amounts to 1,455,-923,000 inhabitants."

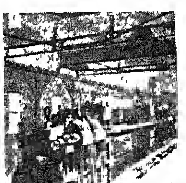
WIND—"Mr. Max Nicolaus, editor of the *Avalanche*, Sauk Center, Minn., has two job presses run by a windmill. . . . Wind is an important agent in the running of political newspapers, especially about election time, but its employment in such prosaic service as doing useful commercial printing is, we believe, quite exceptional."

WELL—"The deepest well drilled in the United States is that of George Westinghouse, at Homewood, near the city of Pittsburgh, which had reached a depth of 4,618 feet, when the tools were lost and drilling ceased."

INTROVERT—"In any line of business, the man who uses reasonable economy and has the ability to give fair management and the perseverance to hold on will, in a great majority of cases, make a success; while, on the other hand, the one who rushes into whatever he has undertaken with a spasmodic endeavor to win all at once, as a general rule wastes his energies and often fails for sheer want of perseverance."

CATAMARAN—"A steam catamaran, intended for whale and walrus hunting in the Arctic regions, is being built at Montreal, Canada. It has two steel cigar-shaped hulls, each sixty-five feet long, and built in two compartments, one for water ballast, and the other to carry petroleum for fuel. The catamaran is constructed so that it may be taken apart for transportation on the deck of a whaler."

TESTING—"The great testing machine at the United States Arsenal at Watertown, Mass., in the environs of Boston, is properly considered one of the engineering triumphs of its day. A machine which will break by tension a five inch bar requiring 350 tons stress, and immediately after the strain and shock of recoil due to this performance will break a horse hair, and indicate perfectly the required rupturing tension of one pound, must be mechanically perfect. . . . The machine works by hydraulic pressure for heavy strains, while for light ones, and especially for such as require a very large range for stretching or contracting, screw power can be effectively applied. . . . Elaborate sets of calipers and all necessary accessories are supplied for testing elongation under stress, and other factors and data."



PHONOGRAPH—"A very interesting and popular use of the phonograph will be the distribution of the songs of great singers, sermons, and speeches, the words of great men and women, music of many parts, the voices of animals, etc., so that the owner of a phonograph may enjoy these things with little expense."

KEELY—"Mr. Keely, the man whose motor was to revolutionize the machinery of the world, is hardly off with the old force before he is on with the new. At a meeting of the stockholders of his company in Philadelphia, Mr. Keely explained that, while experimenting with his etheric or vapor force, he has run against another form of energy, the properties of which are so captivating as to cast into shade those of his first enchantress." [The Keely motor was a famous fraud.—*Ed.*]

AND NOW FOR THE FUTURE

**What can be done about the rare and vanishing species of American wildlife? By Ira N. Gabrielson, Chief, Bureau of Biological Survey.**

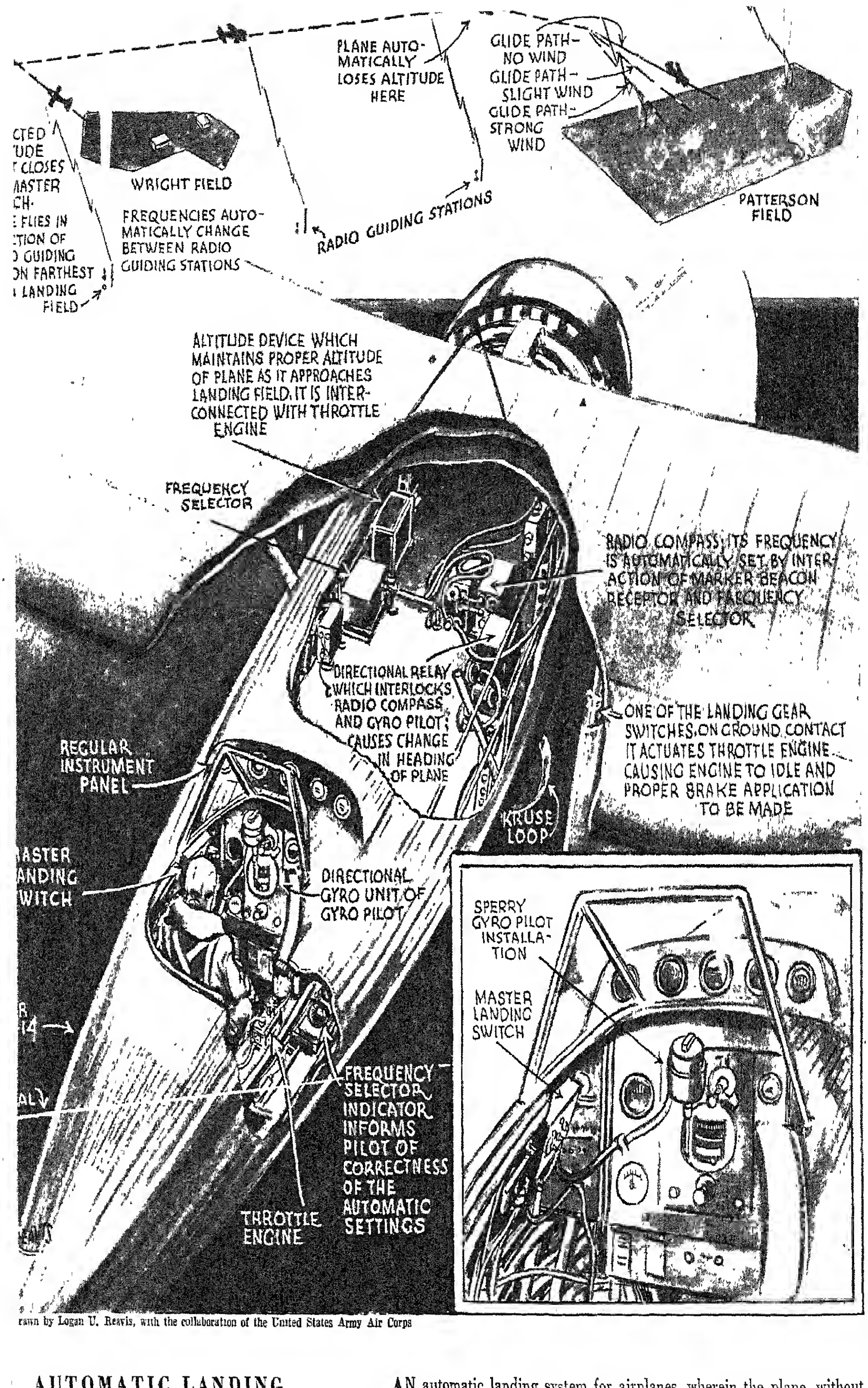
**Abrasives make precision products, by Philip H. Smith.**

**Birth of a plastic—told in photographs.**

**Clean air to aid many industries, by John F. McMahon.**

**The concluding installment of the life and death of Ra-mose and Hat-nufer.**

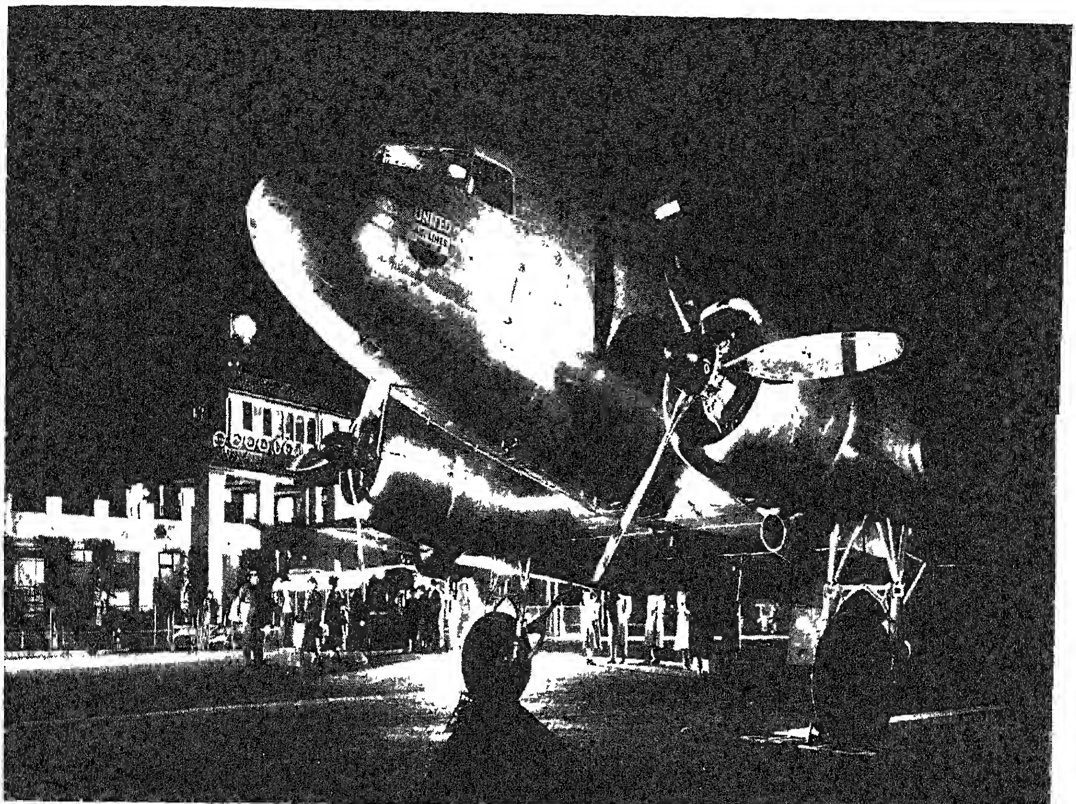

"It's Good to Hear Your Voice"
THE tinkle of the telephone is a welcome sound in millions of homes. This day, the sun will shine brighter for some one because you called.
The telephone is important in the everyday affairs of life—vital in emergencies. But that is not the whole of its service. Its value grows because it helps to keep folks closer—makes this busy world a happier, cheerier place to live in.
Friendship's path often follows the trail of the telephone wires.
LONG DISTANCE RATES ARE LOW
Your friends will be glad to hear your voice and you'll be surprised to see how little it costs to telephone Long Distance. Rates to most points are lowest after 7 P.M. and all day Sunday. Then 3-minute station-to-station calls cost 35c for about 90 miles; 50c for about 150 miles; $1 for about 425 miles.
BELL TELEPHONE SYSTEM




rawn by Logan U. Reavis, with the collaboration of the United States Army Air Corps

## AUTOMATIC LANDING FOR AIRPLANES

An automatic landing system for airplanes, wherein the plane, without human contact with its instruments, literally finds its own way to the landing field and makes a safe landing, has been designed and reduced to practice by a group of engineers co-operating with the Army Air Corps. Making use of radio guiding stations that control the heading and altitude of the plane through a Gyro-pilot and the speed of the engine through a small throttle engine, the system has been put through a rigorous series of tests, many of which were conducted under moderately rough air conditions. The operation (see illustration) is briefly as follows: The pilot brings the plane within range of the landing field's radio facilities and to a certain altitude as indicated by a sensitive altimeter. He then closes the master landing switch and automatic control is established. Responsive to the successive frequencies of the guiding stations, the various units take over their own particular functions and bring the plane to a landing at an angle that depends upon the resistance of the wind. The drawing gives additional operating details of this promising system.



One of the sleeper *Mainliners* used in the overnight coast-to-coast service

# AIR TRANSPORTATION

## 1927 1937 The Future

### Transcontinental Flying Time Cut by More Than 50 Percent...Research and Experience Have Vastly Increased Safety and Comfort . . . Things to Come

By BOB JOHNSON

ALTHOUGH the beginning of scheduled flying in the United States can be traced back to pre-War days, when optimistic airplane operators launched the nation's first airlines on a small scale, and although the maintenance of regular air schedules invaded the coast-to-coast field as early as 1920, when the Post Office Department completed its pioneer mail route across the country, the inauguration of regular air travel between the Atlantic and Pacific came in September, 1927. It was then that commercial companies took over the operation of scheduled airmail and simultaneously provided facilities for passenger service across the New York-Chicago-California airway.

At the beginning of air transportation's first decade, pioneer air travelers rode across the continent in single-engined mail-passenger planes which required 33 hours to complete the 2700-mile journey. Today the same route is flown with giant twin-engined airliners in 15 hours. Thousands of persons now make the cross-continent flight in a routine manner during a single month, as against the adventurous baker's dozen who essayed that trip ten years ago.

As air transportation enters upon its second decade, one has only to contrast today's operations to the pioneering service of 1927 to foresee the progress which airlines may reasonably be expected to achieve during the coming ten years.

In reviewing air transportation in this country it is evident that technical development must receive a major share of the credit for the growth in air travel which has resulted in the carrying of a million and a quarter passengers on regular airline schedules during 1937. In 1927 flying was still in its "helmet and goggle" days, and the operation of an airline depended principally upon the pilot and his airplane, with the emphasis upon the pilot. The immediate problems which confronted the airline operator included lack of communication between planes and the ground, absence of organized weather observing and reporting systems, lack of adequate instruments for accurate air navigation, limitations of airplanes in cruising range, and limitations of aircraft powerplants in maintaining sustained operation and in functioning efficiently at high cruising altitudes free from weather disturbances.

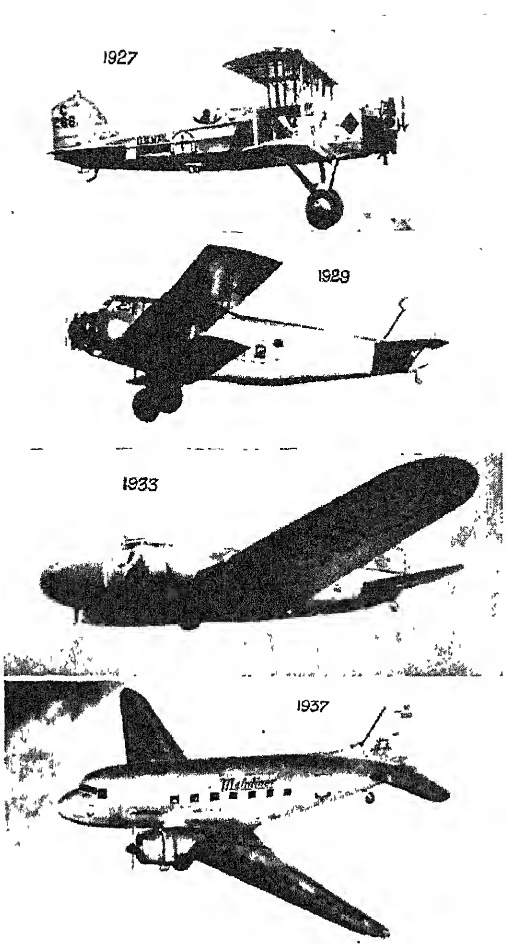
In ten short years technical research and development has contributed satisfactory answers to all these problems.

By developing two-way voice radio communication between planes and the

ground and by evolving the directive radio-range system of marking airways, radio engineers of airlines and manufacturers made two of the greatest contributions to the dependable operation of airliners.

The combined forces of the Department of Agriculture, Department of Commerce, and the airlines themselves established a systematic organization for observing, reporting, and analysing weather that not only has placed the handling of airway weather conditions on a scientific basis, but likewise has made important contributions to the knowledge of weather in general.

In addition to the aid to air navigation of the radio marking of airways, instruments have been developed to the point where the "art" of flying has been changed to the "science" of flying.



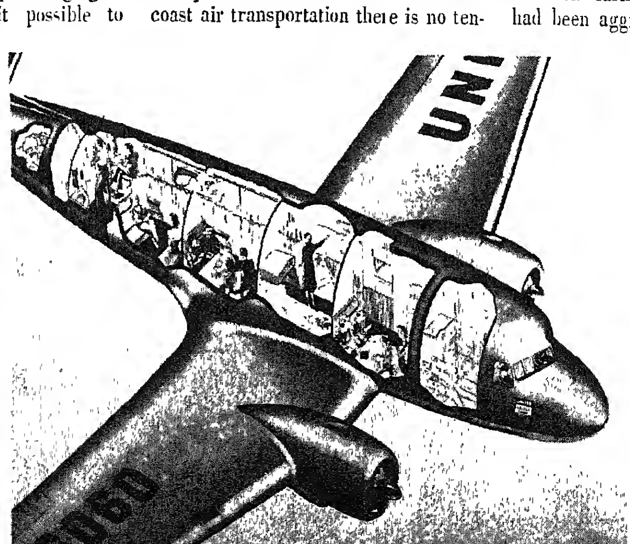
Ten years of progress in coast-to-coast airliners: a two-passenger plane with which the service was inaugurated 10 years ago; a tri-motored transport; a low-wing twin-engined monoplane; and one of the latest *Mainliners*

THE airplane of 1927 was required to make 14 stops during a trip from coast to coast, while today's transports are required to make only three stops and can actually cross the continent with only two stops, because of their great reserve cruising range.

While mechanical forced landings on account of engine trouble were relatively frequent during the pioneering days, they are now almost non-existent; for, in addition to mechanical excellence of modern engines and systematic methods of routine overhaul, today's airliner can sustain flight with only one of its two engines in operation. Supercharging of these engines makes it possible to operate schedules at cruising altitudes approximating 10,000 feet, clearing the low overcast conditions which hampered early-day operation and avoiding the turbulent air conditions that prevail at low elevations and which were responsible for considerable discomfort to passengers during the first years of cross-continent flying.

While the task of technical advancement in scheduled air transportation has been complex, the efficient operating records established by airlines of today represent a tribute to the engineers of the lines and companies allied with the industry, in bringing under control the natural and mechanical elements which presented obstacles to the efficient maintenance of schedules. As the airlines enter upon the second decade of coast-to-coast air transportation there is no tendency to relax the efforts to advance the science of air transportation; this is going forward steadily in the directions both of refining present facilities and of solving those technical problems which remain. As a matter of fact, the year 1937 is noteworthy for several outstanding contributions to the technical progress of the industry. From the airport and flying laboratories of the airlines have come two major projects during the year, with others well under way.

ONE significant problem which confronted air transportation at the beginning of 1937 was the so-called "snow and rain" static which stood in the way of positive use of such radio facilities as the short-wave equipment for voice communication between planes and the ground, the long-wave radio range and radio marker systems, and the airport approach facilities. This problem was not so acute during the earlier years of flying but, with the advent of the current three-mile-a-minute all-metal transports, it became so serious that efforts were concentrated on its solution. The accepted theory was that the impinging of electrically charged particles of moisture and dust on the surfaces of airliners created the natural static which interfered with clear reception of radio signals and at times even blocked them out, and it was believed that with the substitution of metal skin as the covering for airplanes, in place of the fabric used on earlier planes, this situation had been aggravated. Efforts to shield antennas against the static proved only partially successful. Then United Air Lines assigned its flying laboratory—a conventional Boeing *247-D* twin-engined passenger airliner with its cabin converted to a regular laboratory—to the project of developing a more positive method of eliminating the trouble.


All illustrations courtesy United Air Lines
**An artist's conception of a modern sleeper plane in flight, showing the comfortable arrangement of compartments and berths in the fuselage**

For three months during the late spring of 1937 this plane hunted static. Under the direction of a communications engineer a party of airline technicians, radio equipment man-

ufacturing representatives, and professors of physics studied the static problem on the very scene itself. They deliberately sought out the worst weather conditions, in order that when they completed their work, the steps they had taken to eliminate static would be effective under maximum conditions instead of the more moderate situations prevailing during 99 percent of scheduled airline operation.

The results of these experiments were revolutionary for they developed an entirely new fact—that static interference resulted from the discharge of snow and rain static from the airplane on which it had accumulated, instead of from the impinging of the electrically charged particles on the surfaces of the ship.

With the real cause of this trouble ascertained, the way was paved for the proper solution. This has come in the form of a static-discharge system comprised of trailing wires, by means of which the discharge of the static of the airplane is so controlled as to reduce its effect to a negligible point and thus insure constant and true reception of radio signals. This system is being supplemented with shielded antennas as well as the use of radio transmitters of greater power in order to permit a consequent lower volume regulation of receivers.

THE importance of this development lies in its insurance that the transport plane can fly from destination to destination over the established airway with its pilots able to use to the fullest extent the positive radio markings.

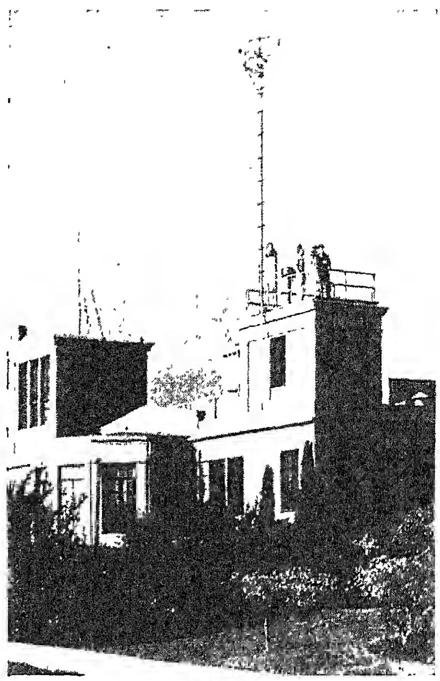
This leads to another obstacle remaining in the path of positive all-weather air-transport operation—accomplishing landings at airports under conditions of poor visibility. In the past, as today, airline operation has recognized ceiling and visibility limitations to safe landings at airports, and schedules are not operated when weather conditions do not conform with the safe minimums of ceiling and visibility. In fact, through the exacting weather reporting and dispatching procedures of the established lines, when conditions at a terminal destination are changeable and indications are that they might develop unfavorably beyond the limitations, no trips are dispatched unless alternate terminals with definitely favorable conditions are available. When conditions at the destination are such that limitations are definitely exceeded, trips are cancelled. The number of cases where such conditions are encountered is extremely small but, nevertheless, such conditions do exist and, therefore, airlines have not been able to achieve 100 percent all-weather operation.

The answer to this problem was furnished during 1937 with the successful completion of years of experimentation of instrument landings. Since as early as 1919, research on this project has been under way and by 1929 concrete results were being obtained. During the following year several systems of instrument and radio landings were effected but none of them was completely satisfactory, with two difficulties generally being encountered. One was the failure to obtain a precise, constant, radio landing beam and the other was to overcome a certain amount of variation of landing procedure, chargeable to the human element.

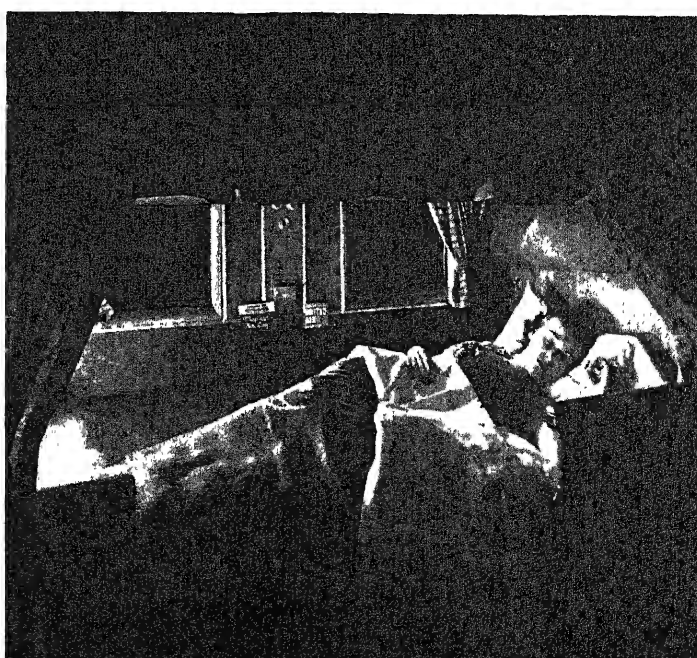
The major airlines, working with an equipment manufacturer, took the best features of the systems then in existence and overcame the difficulties by using an ultra-high-frequency transmitter for the transmission of the landing beam signals and by applying the automatic pilot to obtain uniform landing procedure. Thus, in the late summer of 1937, members of the Radio Technical Committee for Aeronautics, engineers representing airlines, manufacturers, the Army, Navy, Bureau of Air Commerce, and other interested agencies assembled at the Oakland Municipal Airport to observe a system on which several thousand automatic landings of conventional type transport planes had been effected.

This system fundamentally involves these factors: An ultra-high-frequency runway localizer and glide path, ultra-high-frequency radio markers identifying points at regular intervals on the approach to the airport itself, and satisfactory visual and aural indicating facilities.

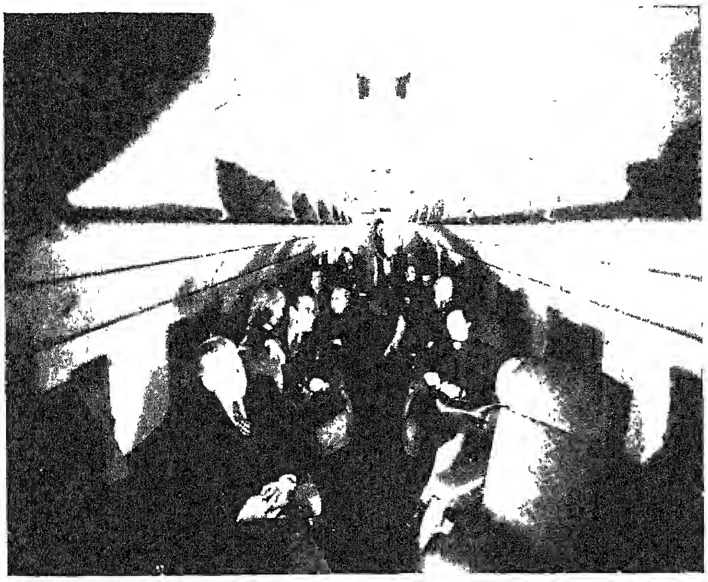
In actual operation the pilot of a transport plane equipped with an instrument landing system approaches the field and bisects the glide path and the signals of the runway localizer at a point approximately five miles from the boundary of the field and 1500 feet above the terrain. Maneuvering his plane



A United States Weather Bureau airway station. Efficient weather reporting and analysis are important in dependable airline operation



Solid comfort aloft. The comfortable berth in one of the modern sleeper planes of United Air Lines is six and a half feet long, and as wide as a standard twin bed



Introducing the extra-fare note in air travel, the *Skylounge Mainliner* offers the luxury of 14 swivel chairs in a cabin that is large enough for 21 standard seats

so that the indicators show it is exactly on the glide path and aligned with the airport runways, the pilot throttles back to a speed of in the neighborhood of 90 miles per hour and either engages the automatic pilot to hold the plane in its exact position on this course, or controls the plane himself in a similar manner, and then literally follows the radio signals to a complete landing.

THE application of the landing system to regular scheduled air transport is still a matter of many months or even two years in the future. Its installation on the airways will, in all probability, be undertaken by the Bureau of Air Commerce in order to obtain a uniform system at all fields on the Federal airways network. Following the installation there will be a period of pilot training to familiarize all flying personnel with the operation of this system. Until these preliminaries are satisfactorily accomplished, the landing system will not be applied to scheduled flying. However, the obstacle of so-called blind landings has been successfully overcome and it is only a matter of time until the benefits of this development will be reflected in an even higher record of safely completed flights on the established airlines of this country.

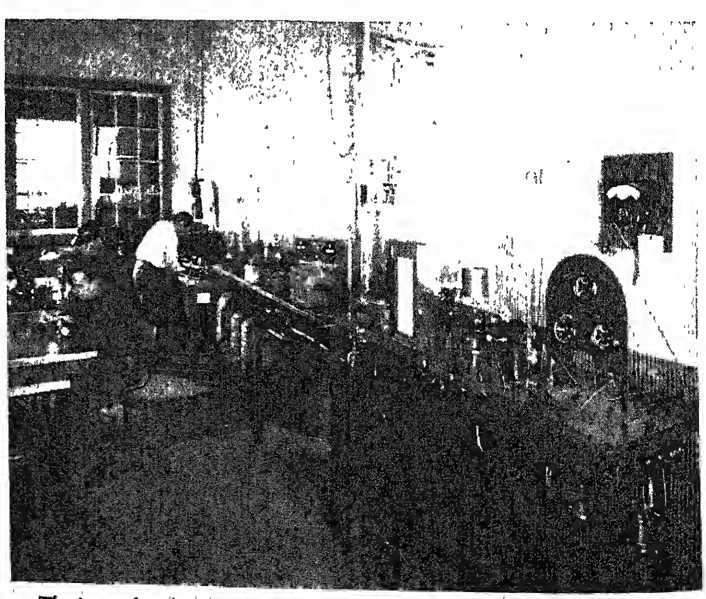
These developments clearly mark the path which airlines are taking to achieve automatic flight. As a matter of actual record, the use of automatic pilots, which are standard on the major airlines, has progressed to the point where the Gyro-pilots actually control the physical flight of the plane on as high as 85 percent of scheduled flights across the airways. The human pilots control the planes during take-offs and landings, but during the flight at cruising elevations, the automatic pilots relieve them and allow more time for the actual navigation of the course, the regulation of the power-plants, and other details incident to flight.

With the adoption of instrument landings it is apparent that the mechanical end of the operation of airplanes can become virtually automatic, and this step will bring to a completion the evolution of airline operation from a matter of flying to one of navigating.

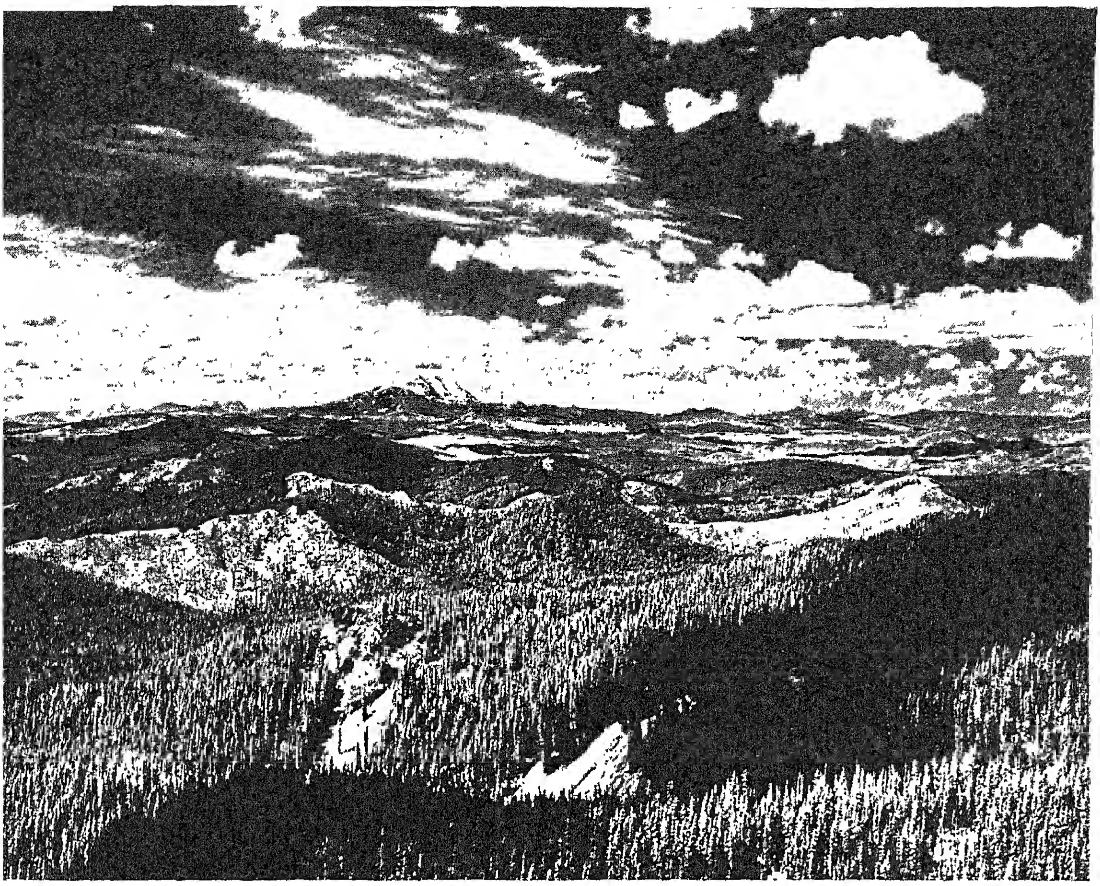
Still another development which is now in progress and which will contribute much to the positive navigation of planes across the nation's airways is that of ground direction-finding systems. Until recently the work on direction-finding equipment for land planes has been confined largely to experimentation with aircraft direction-finding equipment, the installation of such equipment being on the airplanes themselves and the burden of their use on the pilots. In order to achieve a more positive system, engineers are now at work on ground direction-finding equipment, and while this engineering is still in its early stages, indications point to a successful completion of this project early in 1938, which should result in a method of locating the positions of planes in flight over the airways that will be both instantaneous and automatic.

HERE, then, is another achievement of airline engineers to control air navigation scientifically and further to reduce the human element. Meanwhile, the results of years of planning on the part of airline and factory engineers are being manifested in the imposing 4-motored *DC-4* project now well into actual construction at the Douglas Aircraft factory at Santa Monica, California. This 40-passenger 65,000-pound giant of the airways will be test flown in 1938. It represents the engineering experience and specifications of five major airlines—United, American, TWA, Pan American, and Eastern—as well as the engineers of the factory.

When one appreciates the swift progress which was achieved in air transportation during the first decade, from the small, poorly equipped single-engined plane of 1927 to the scientifically operated 12-ton airliners of today, one realizes the futility of attempting to forecast the status of air transportation in 1947. But the *DC-4* is tangible evidence of where air transportation is going. This giant plane should be in service in 1939, and with the requirement that it be able to fly on any two of its four motors and with its great cruising range, coupled with the many engineering requirements which have been built into its specifications, this project points the way to even greater dependability of operation.

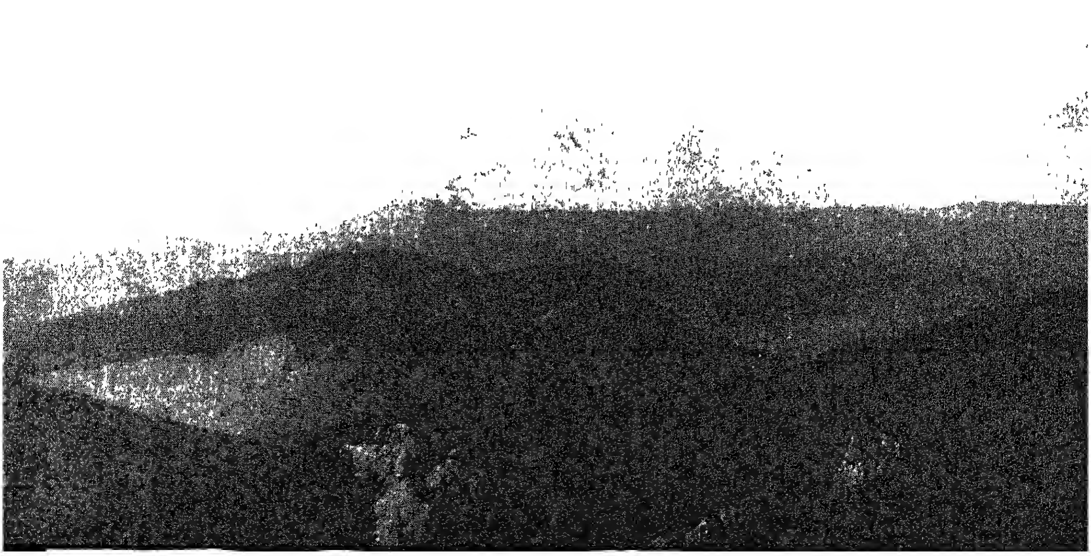


The inspection department at an airline base, where servicing and maintenance methods are tested and checked to insure efficient performance on schedule



# As the Camera Sees it

STRIKINGLY illustrative of the difference between photographs taken on ordinary negatives and those made on special negative material that is sensitive to infra-red rays, the pictures above and below were taken within a few minutes of each other, under identical conditions of lighting. Both exposures were made with the same camera and lens; the view is from the slope of Mt. Hood, Oregon, looking south, with Mt. Jefferson on the skyline 48 miles away. The photograph above was made on a type 1-R infra-red plate with a Wratten "A" filter, exposure four seconds at F:16. The one below was taken on Commercial Ortho cut film with a Wratten K-2 filter, exposure 1/5 second at F:16.—*B. W. Leroy*.



# RA-MOSE AND HAT-NUFER*

## Woman's Rights in Ancient Egypt . . . Hat-Nufer's Mummy Glittered with Rings and Scarabs but Her Husband, at Time of Burial, Was Out of Funds

By AMBROSE LANSING
Associate Curator of the Department of Egyptian Art of the Metropolitan Museum of Art; In Charge, Metropolitan Museum Excavations in Egypt

and WILLIAM C. HAYES
Assistant Curator of the Department of Egyptian Art of the Metropolitan Museum of Art

*(In Three Parts—Part Two)*

THE tomb entirely cleared, we set ourselves to the long and interesting task of opening the coffins, boxes, and baskets, noting their material, construction, and so on, and thoroughly investigating their contents—a series of operations carried out in the workroom. under the watchful and infallible eye of Burton's camera.

Ra-mose's coffin was the first opened—not without misgivings as to its contents, for the coffin itself is of mediocre quality, enriched only by the thin gold foil with which the face, throat, and ears are covered. Four wooden pegs fastened the lid in place, but they were provided with rounded heads and were easily withdrawn, allowing the lid to be removed without difficulty. Our pessimism was more than justified, for, with the exception of Ra-mose's disjointed skeleton, packed in a mass of mud and gravel and wrapped in layers of linen sheets (including an old shirt) and bandages, the coffin contained not a single object, funerary or otherwise. Two of the bandages were marked in ink with the cartouche of the Princess Nefru-Rē, daughter of Hat-shepsut and Thut-mose II, a fact which indicates that, as in most of the other burials in the tomb, some of Ra-mose's linen was drawn from the royal store. An examination of the skeleton showed that Ra-mose, short and lightly built, was an elderly man. His head, crowned by long, wavy hair, still dark brown in color at the time of death, is of intellectual type, with high, vertical forehead and great breadth across the back of the skull.

The poverty of the burial of Sen-Mut's father, whom we should have expected to surpass all the other occupants of the chamber in the quality and the extent of his funerary equipment and personal possessions, is perhaps the most striking feature of the contents of the tomb. Clearly, the style with which an ancient Egyptian was buried depended on his own state of prosperity at the time of his death rather than upon the filial piety of his children, which, however elaborately protested it may have been, did not, in this case at least, include the outlay of benefits of a material nature. Ra-mose was evidently not only an insignificant man but also an exceptionally poor man.

Hat-nufer's burial was another story. Sen-Mut's mother was clearly a lady of means and the fact that she was able to maintain her right of possession independent of her husband is an interesting commentary on the position and privileges of women in ancient Egypt.

*Figure 9:* The coffin of Hat-nufer

Her large and well-built coffin (Figure 9), "pitched within and without," is elaborately modeled to represent a mummiform human figure with the arms crossed over the breast and each hand holding a papyrus flower. The eyes are inlaid in ebony, alabaster, and obsidian, and the face and throat are covered with gold foil, which is also used to overlay the inscribed bands, the broad collar, and so on. Among the elements of the decoration added in paint are polychrome figures of the goddesses Nephthys and Isis on the ends of the coffin. Although lacking in fineness of detail, the coffin is a handsome monument, and its black and gold color scheme is most effective.

THE removal of its lid required considerable ingenuity, for an intricate locking device, which left no clue as to its nature or mechanics on the exterior of the coffin, held the cover and the coffin firmly clamped together. Four stout tenons shaped like inverted wedges, descending from the underside of the rim of the lid, could be removed from specially shaped mortises in the rim of the coffin only by first sliding the whole lid horizontally in the direction of the head end. To prevent this there was a wooden tumbler in the head end of the lid which, when the cover was originally lowered onto the coffin and subsequently slid into place, swung of its own weight down into a transverse mortise in the rim of the box and effectively checked any longitudinal movement of the lid. A good, heavy ax, much favored by our ancient predecessors in the art of opening coffins, would have solved our problem very simply. Actually, after a series of gentle soundings had revealed the secret of the system, a thin blade was used to push the troublesome tumbler at the head end up into its slot, and by means of this expedient the lid was removed without the slightest

*Courtesy the *Bulletin* of the Metropolitan Museum of Art.

damage either to itself or to the coffin.

Covering and surrounding the body in the coffin were 18 shawls and sheets of linen, some spread out over the top, some rolled, twisted, or folded into wads and packed tightly around the sides of the copiously wrapped mummy. Most of these were stuck in places to the pitch on the interior surfaces of the coffin, evidently still fresh and sticky when the contents were inserted.

WHEN the outer coverings had been removed, the mummy, fully wrapped, the head and shoulders incased in a gilt mask, was revealed, not sharply but through a filmy shroud of fine linen inscribed with funerary texts in black and red ink (Figure 10). Like those of the outer sheets, the edges of the shroud were stuck fast to the pitch on the walls of the coffin, which had to be softened before the inscribed cloth could be freed. This was accomplished with the aid of a chemical bearing the impressive name of orthodichlorbenzene and the shroud was salvaged in one piece, complete except for a few small portions which had become moldy and fallen to powder. It is inscribed with 51 vertical columns of cursive hieroglyphic, comprising two of the most ancient and most important spells, or "chapters," from the Book of the Dead: Chapters 72 and 17 (Figure 11). Both spells are recited here by "the honored one, Hat-nufer, the deceased," who, we now learned, was called "Tjutju" for short—a nickname by which she was probably known among her friends.

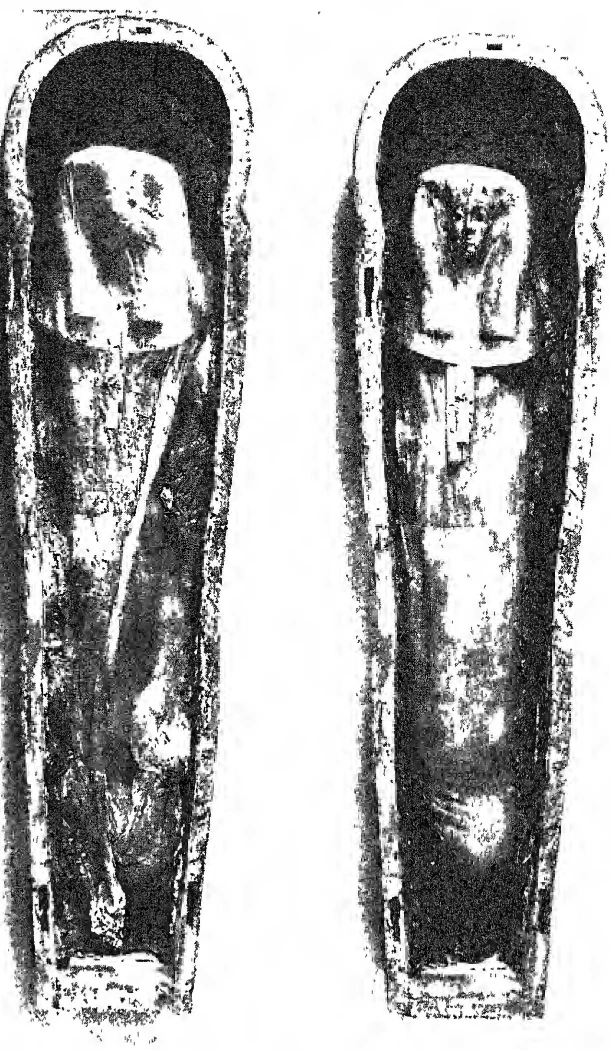


*Figure 10:* **The mummy of Hat-nufer before and after the removal of the shroud**

The funerary mask (in Figure 10, right) is a hollow, cartonnage shell, composed of 11 layers of coarse linen cloth, coated inside and out with fine white stucco. The eyes are inlaid and the whole of the exterior is covered with gold foil. Unfortunately the linen body of the fabric was everywhere badly rotted, the whole mask slightly shrunken, and the foil very loose. In addition, the sides and bottom of the mask were stuck fast, not only to the unguent-drenched mummy wrappings, but also to the heavy coating of pitch on the floor and walls of the coffin. It was removed, only with the greatest difficulty, in two sections and has had to be extensively reinforced and restored for future preservation.

On the breast of the mummy, outside all the wrappings proper, lay a bundle, tied with a linen tape and consisting of two rolls of papyrus and a roll of leather. Owing to the extreme dryness of the climate of Upper Egypt it seemed wise not to attempt to unroll the papyri on the spot; but the larger roll is identified by a hieratic title on its exterior as a Book of the Dead, and the smaller was tentatively conjectured to be a Book of Emy Det ("He-Who-is-in-the-Underworld"). When found, both were complete and in good condition, as was also the leather roll. The latter was subsequently opened for inspection by the officials of the Cairo Museum, and its nature and contents are therefore known to us. The text is Chapter 100 of the Book of the Dead. It is accompanied as usual by a vignette depicting the deceased, in this case Hat-nufer, in the bark of the sun-god together with a group of four divinities who are described in the text as the

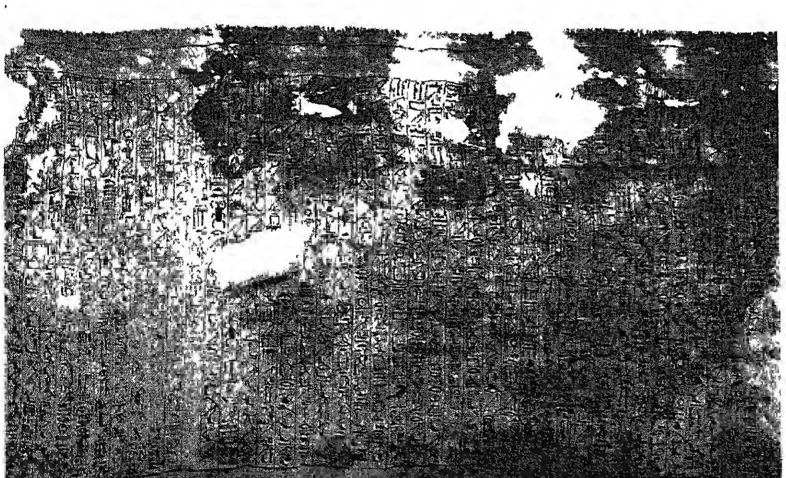


*Figure 11:* **A portion of the inscribed shroud of linen on Hat-nufer's coffin**

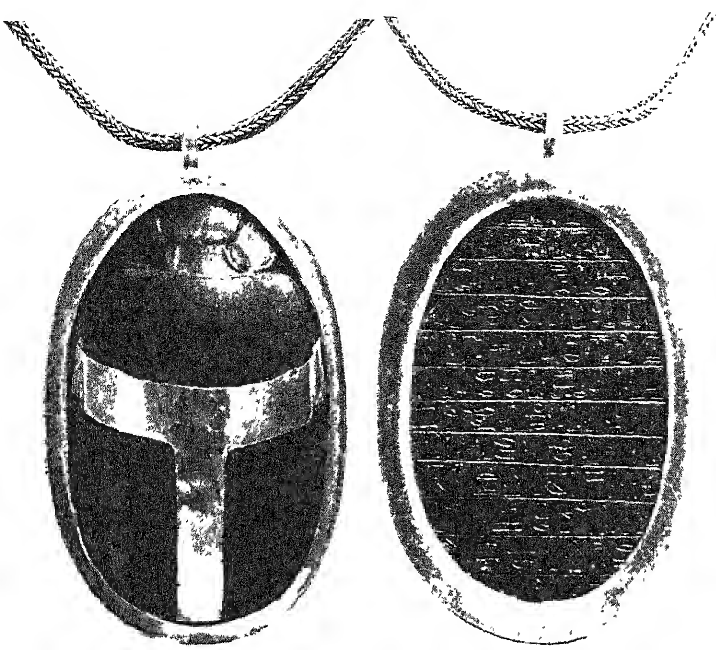


*Figure 12:* **Hat-nufer's heart scarab, which was worn like a locket, around the neck. At left is the back and at right the inscribed base worn next the chest**

"followers of Rē"—that is, of the Sun-god.

Lying over the throat and upper breast of the mummy, outside the wrappings but hidden under the front of the mask, was a heart scarab of hard green stone, set in a heavy gold mounting (Figure 12) and equipped with a suspension cord composed of innumerable, interlacing links of fine gold wire—a marvel of the Egyptian jeweler's art. Near this, over the right shoulder of the mummy, lay a small silver "pocket" mirror with carved wooden handle, less than 12 centimeters long over all.

THE well-preserved mummy of Hat-nufer was almost lost in a colossal bale of carefully applied linen wrappings. Four full days were taken up in recording and removing, one by one, the 14 sheets, 80 bandages, 12 pads, and four sets of trussing tapes which composed these wrappings. The body itself was clad in a loincloth composed of two linen shirts, their tops tied around the waist, the tails brought up between the legs and tucked into the waist loop. The

**Portrait sketch of Sen-Mut. Others that were found showed the same pronounced lines about the mouth**

*Figure 13:* **Hat-nufer's head**

head of the mummy (Figure 13) was adorned by two long, heavy rolls, or "switches," of false hair, each made up of an enormous number of fine, tapering braids of black, human hair, their upper ends braided into Hat-nufer's own sparse, gray locks on either side of the crown of the head, the mass of the rolls falling down over the ears and ending in flat, spiraled disks on the upper breast.

Hat-nufer's left hand and wrist glittered with signet rings and scarabs (Figure 14). The rings, three in number, were worn on the second, third, and fourth fingers. Their bezels—two scaraboids and a button seal—are of blue-glazed steatite, the rings themselves and the swivel mountings being of gold and silver. One of the scaraboids has the figure of a scorpion engraved on its underside. The designs on the other two bezels are purely decorative patterns. A fine blue scarab, tied by a loop of string to the thumb of the same hand, bears the personal name of Hat-shepsut accompanied by the title "God's Wife," a title which she bore as crown princess or as queen of Thut-mose II. Another scarab, with dark blue glaze and displaying on its underside a complicated linear design, had been tied to the wrist with a length of linen cord.

Hat-nufer was an old woman at the time of her death. Short and, though delicately boned, distinctly fat, she was pathetically unlike the slender and graceful young woman depicted in the tomb of her son.

It is safe to assume that, with the obvious exception of the two rectangular coffins, all the remaining objects from the tomb, including the Canopic chest, were the property of Hat-nufer. None bears the name of its owner, but a number of pertinent considerations make the foregoing assumption reasonably certain of accuracy. That the objects formed one group and belonged to one person is indicated by the fact that there are no real duplicates among them. True, there are seven baskets, three boxes, three alabaster jars, seven pottery jars, and six pottery dishes, but these had no individual use except as containers, and one person could have possessed 50 of each, if the commodities supplied to him (or her) required as many containers. The whole group of objects, on the other hand, includes only one Canopic chest, one razor, one pair of sandals, one kohl jar and stick, one

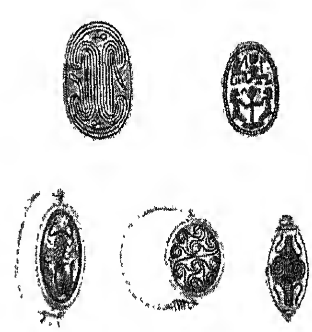


*Figure 14:* **Gold and silver scarabs from the left hand of Hat-nufer**

pillow, one set of silver vessels, and one bead necklace. All are appropriate to a woman, and, of all the burials in the tomb, Hat-nufer's is the only one rich enough to be consistent with the ownership of this large group of fine articles. What few objects the occupants of the rectangular coffins possessed were found on their bodies; and, since Ra-mose was evidently too poor to own even the essential items of funerary equipment and personal adornment usually found in the coffin or on the body, it is unlikely that he had a share in such extraneous luxuries as boxes of spare linen, store jars of precious oils, fine toilet articles, and the like.

*(To be concluded)*

# OUR POINT OF VIEW

### "Thar She Blows!"

THANKS to the common sense and co-operativeness of 11 governments representing both the economic interests of the whaling industry and the broad interest of science in the preservation of our remaining fauna, that valuable and ever-fascinating aquatic mammal the whale, by far the hugest bulk of animate flesh this old earth has known at any period, is now probably saved. The world will know the definite answer within a few years.

Last summer, after protracted meetings, the delegates of the whaling nations—Norway, those of the British nations which do whaling, the Irish Free State, the United States, and Germany—came to an agreement which is to be tried out for at least one year. Game laws are now to be applied to whales. Since the participants have known that with present methods an early extinction of their source of living was in clear sight, the chances are that the agreement will be made to work and that it will be extended from year to year. These game laws of the international whaling industry are to go into effect in the most important area of that industry, the Antarctic regions, on December 8, and whaling will continue only until March 7 when a closed season will begin.

Some species of whales are to be protected completely: right whales, gray whales, cow whales with calves, and immature whales. To cramp the style of the greediest individuals and save the whales to propagate more, the pay of the gunners who perch on the foredecks of the modern steam whalers and shoot the Svend-Foyn gun with its 100-pound harpoon that carries an explosive bullet, is no longer to depend merely on the number of whales they kill. Moreover, whaling vessels must now keep full records of all whales killed.

In general, there are two kinds of whales—those that have teeth and can use them fiercely, and the great toothless hulks which feed wholly by sifting vast volumes of water through whalebone sieves in order to obtain its content of those tiny forms of life collectively called plankton and found in special abundance in the waters of the Arctic and Antarctic because these cold waters are the richest in nutrient salts. That huge chunk of frenzied fight, the sperm whale or cachelot, the familiar fellow with the high forehead and a head that runs a whole third the length of his body—the ugly one with huge jaws that crush boats in the illustrations of sea stories, and which could easily have swallowed Jonah—may not be killed if less than 35 feet in length, and the female of this species may not be killed at all. The famous blue whale, known as the sulfur-bottom when its body is covered with diatoms—a regular *whale* of a whale, and, in fact, the largest whale of all, with a mean size of about 75 feet—must first reach a length of 70 feet before it is now eligible for the kill. This is one of the sieve feeders, with a bulk sometimes of 85 tons and with room inside to stuff three jumbo elephants plus the largest dinosaur that ever lived. Yet it is supported wholly on near-microscopic mincemeat and its throat is so small that it would have choked to death on Jonah's head alone. Other restrictions prohibit, over vast areas of ocean, including the whole Atlantic north of Patagonia, the use of those too efficient, mechanized "floating factories"—steamships that skid killed whales up inclines into their opened maws and treat them on the broad seas.

Drastic restrictions, these. Yet they are the doctor's orders for the good of a very sick patient (has the modern gunner not killed 100 whales to the old harpooner's one?) and nobody knows it better than the whaling industry of the nations, except apparently Japan, which is the one important non-signatory.

Before these restrictions could be applied intelligently it was necessary to learn about the lives of whales. Here one might think the old whalers could tell us the whole story, but this is an illusion, for whalers have been interested in making their living, not in natural history. So two English vessels, the *Discovery* and the *William Scoresby*, have been patiently plodding up and down the seas for the past dozen years snooping everywhere into the ways of whales—their movements and migrations, their food, and their everything. They have marked 4000 whales with darts: another version of bird-banding, and with a similar purpose. More than 90 of these 4000 darts have been returned by whalers.

To strike a sane middle-of-the-road course between the dreams of the sentimentalists who would see none of our forests cut, and the hogs who would see none left, conservationists now regard trees in the light of a crop and aim to provide for the future—*enough.* So with the whaling conservationists—whales are to be run exactly as a crop, for there is little sentiment in the question. The purpose is simply to see that the whaling industry is provided with "enough" whales—the meaning of enough being expressed in permanent terms and not in those of a short-sighted decade or two. However, notwithstanding the lack of sentiment expressed by those practical men who have made the agreement, the world will applaud it also on sentimental grounds; for how could future generations of boys find whaling stories good meat if there were no more real whales plowing the wide reaches of the chill Antarctic seas? This, therefore, is game protection on a grand and romantic scale. May it save the whale from going the tragic way of the buffalo.

### Are We Wholly Intelligent?

NOW that this past summer has brought a fine rainfall and a good crop in our Dust Bowl, everybody will forget all about the bitter experiences of the two recent droughts. The past is past and never can harm anyone, the present is not harming us, while the future isn't here yet, so why worry? Besides, maybe luck will run better next time. Maybe the scientists will find (?), before the next drought, some easy, artificial way to make it rain by pressing a button. Maybe none of us will be alive by then anyway. Maybe this or maybe that or something else; for haven't we present and real troubles enough of another kind? Shoo—go 'way—don't be a gloom. Forget it.

Human nature!

Man has occupied the Dust Bowl and observed its climate for about half a century, a long time in terms of one human being's span, but Nature moves on a vaster scale and generally in cycles. Often the cycles have smaller, shorter cycles within them, and the whole would form a kind of pattern or rhythm of climate, if only it really would form a rhythm and thus make itself predictable. Seeking to check on past performances, William Van Royen of the University of Nebraska has been digging up strata of earth which contain evidences of climatic changes long past and he finds proof of droughts that lasted whole half centuries. Such droughts doubtless will recur—why wait helplessly?

Now that we have been on this continent long enough to feel sure we like the place and will stay here, we really ought to study it closely and follow this with a few rational plans. One might be to confine our crops to the parts that are best for raising crops, and use the rest for other purposes. What we need is a permanent policy for these regions, to forestall repetition of sad experiences like the recent ones.

# THE ROTATION OF

## New Research Based on Planetary Nebulae Provides the Most Striking Evidence and the Best Picture of Galactic Rotation Thus Far Made Available

UNTIL about 30 years ago, it was generally believed that the sun, with its attendant planets, lay near the center of the Milky Way. This opinion was not based on any *a priori* assumption of the importance of our own position, but on what looked like good evidence. The stars, down to the limit visible in a two-inch telescope, had been counted and catalogued—almost a million of them in all. There were far more of them per square degree in the Milky Way than near its poles—showing that the stars were more thinly scattered in space in the latter direction. But around the circuit of the galaxy, the "star-density" with which they appear to be scattered over the heavens was substantially the same. Barring obviously local irregularities, there were as many in Cassiopeia as in the Southern Cross—in Gemini as in Sagittarius. It seemed reasonable then to conclude that the stars, in space, were distributed uniformly around us in the galactic plane.

But this conclusion was wrong—not because it did not make sense, but because there was an equally reasonable alternative. It was obviously true that the stars were about equally numerous in all directions (in this plane) *out to the distance to which we can see with a small telescope;* but, beyond this distance, our observations told us nothing.

When, early in the present century, studies and counts came to be extended to objects of great real brightness—such as globular star-clusters and novæ—which could be seen at great distances, it became very plain that these were not distributed uniformly along the Milky Way, but showed a marked concentration on one side of it, centering in the constellation Sagittarius, near the great clouds of very faint stars which are so conspicuous in our summer skies. Evidently, after all, the sun was far off center. Our earlier soundings of space had given the same results in all directions because none of them had reached bottom! They had not gone far enough, for example, to include any of the faint stars which form the great clouds. Had they done so, we would have realized that we were not at the center of things.

AT about the same time Barnard discovered the dark nebulæ—vast obscuring clouds which conceal the Milky Way behind—and it gradually became clear that these clouds were thick and black in the very direction of the galactic center, so that the star-clouds which we see were only at the edge of a great obscured region—which, if seen unobstructed, might far outshine them.

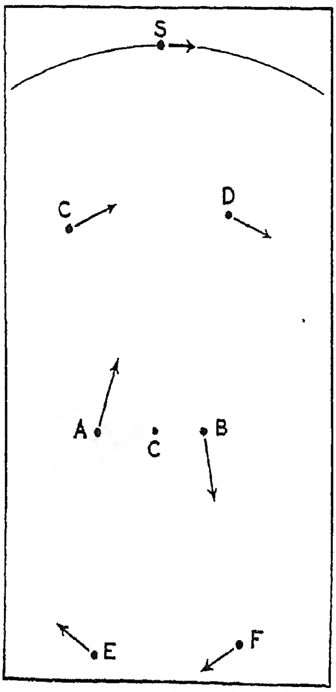



*Figure 1:* **Arrows represent the motions of bodies at different distances from center *C* of galaxy. Sun (with the earth, our viewpoint) is at *S***

Now a flattened, disk-like swarm of stars—or of any other things which are subject to their mutual gravitation—will not be permanent if the stars are at rest; the swarm will slump in toward the center. To keep it flattened, it must be in rotation around its own center. So it was morally certain that the galaxy must be rotating.

For a swarm of uniform density, the rotational velocity (in miles per second, not in years per revolution) would increase outward, so that the whole swarm would revolve almost like a solid block. Such a motion would be very hard to detect by observation. The distances of the stars from one another would not change—barring their random individual motions, which, for the sake of simplicity, we have so far ignored, and which the calculator has not much trouble in allowing for. Moreover, the rotation of the whole mass would be slow—not faster than one turn in 100,000,000 years—and (like that of the earth) it could be detected only by looking at something outside it. The remote spiral nebulæ would do for this purpose, but their exact positions have not been accurately enough observed in the past to detect such small apparent motions.

If, however, the galaxy had a strong central condensation, the chances of detecting its rotation are much better. In this case, the orbital speed of rotation grows faster near the center (as is true for the planets around the sun). Could we detect objects, as far off as the center, and measure their radial velocities, we should find them receding rapidly on one side of it, and approaching on the other, as at *A* and *B* in Figure 1. Those farther from the center would move slower and the effects, for points like *C* and *D*, would be smaller, especially as they would be partly "washed out" by the sun's own motion. For bodies near the sun there would be little difference from our own motion left over to measure. Finally, for bodies more distant than the center, like *E* and *F*, the effects would again be small—provided, indeed, that we could see them at all at such great distances.

NUMEROUS investigations within the last ten years have shown that (when averages are taken to clear out the random motions) the stars which lie on one side of the center in Sagittarius are actually approaching us, and those on the other side receding. For the nearer stars (out to 1000 light-years), the effect is small—showing that the region in which they lie extends to but a small fraction of the distance of the center. When the search is extended to 5000 light-years the effects are more pronounced, but even out to twice this distance there is little sign of that pronounced heaping up of high speeds on each side of the center which we should find if our study had extended to points like *A* and *B* in Figure 1.

This long-desired goal has at last been attained, by an investigation of bodies of a different type—the "planetary" nebulæ.

There is probably no more unfortunate name in astronomical literature

# OUR GALAXY

By HENRY NORRIS RUSSELL, Ph.D.

Chairman of the Department of Astronomy and Director of the Observatory at Princeton University. Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington. President of the American Astronomical Society

than this—though it was given by Herschel, one of the greatest of observers. Here and there in the heavens are roundish patches of greenish light, which look at first glance somewhat like the planet Uranus, whence the name. They are in reality utterly unlike planets in every way. They do not revolve about the sun, but are far off in space: they are not dense opaque bodies, but tenuous envelopes of faintly glowing gas: and, when carefully observed, they are not even round, but of more or less irregular outline. Their bright-line spectra (which closely resemble those of other gaseous nebulosities, like that in Orion), make them among the easiest of all objects to detect, and it is probable that our present list is very nearly complete (down to about the 14th magnitude). It includes not quite 150 of them, so that they are among the most unusual types known to astronomy, and not one of them is bright enough to be seen with the unaided eye. Some of them, such as the well-known ring nebula in Lyra (Figure 2), are bright and big enough to be easily seen in small telescopes; the rest are less conspicuous. A few appear almost like stars, and are identified by their peculiar spectra—though small disks can be seen with high magnifying power.

THE velocities of these nebulæ, down to the faintest, can be observed without much difficulty, since their light is concentrated into a few spectral lines. They are considerably greater, on the average, than those of ordinary stars. A few show very high speeds, exceeding 100 kilometers per second. All these are small, and presumably distant.

The physical nature of these remarkable bodies appears to be well understood. They are huge envelopes of exceedingly rarefied gas, surrounding very hot central stars. Ultra-violet light from the star, absorbed by the gas, sets it shining with visible light—by rather complicated processes, already described in these columns. In most cases, the star looks to us much fainter than the nebula—which indicates that its surface is so exceedingly hot that almost all its radiation is in the ultra-violet and visible to us only because the nebula traps a part of it and transforms it into light which we can see. From this it has been calculated that, when the nucleus and the nebula give out equal amounts of light, the temperature of the former is about 30,000 degrees. In some cases. where the visible light of the nebula is a hundred times that of the nucleus, the latter must be as hot as 80,000 degrees.

A thorough study of the motions of

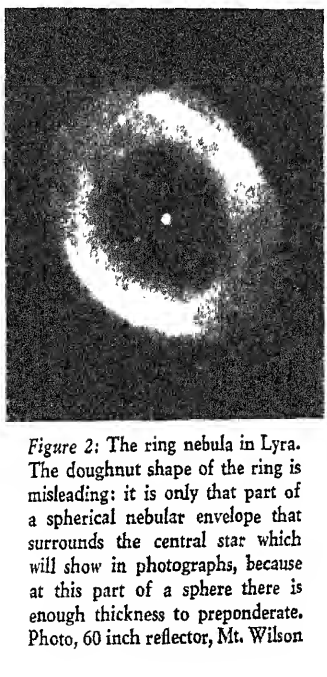


*Figure 2:* **The ring nebula in Lyra. The doughnut shape of the ring is misleading: it is only that part of a spherical nebular envelope that surrounds the central star which will show in photographs, because at this part of a sphere there is enough thickness to preponderate. Photo, 60 inch reflector, Mt. Wilson**

these nebulæ has recently been published by Dr. Berman, a former worker at the Lick Observatory, who is now at the San Francisco Junior College. Comparing the observed radial velocities of planetary nebulæ with the proper motions, observed by van Maanen, and utilizing also the observed brightness, he obtains, by an ingenious series of approximations, estimates of distance ranging from 2500 light-years to almost 60,000.

Though pretty rough, as far as individual nebulæ are concerned, these make it possible to sort them into nearer and more distant groups. When this is done, the remoter, almost star-like, nebulæ show just the distribution of velocity which Figure 1 would lead us to expect. Those to the south of Sagittarius—on the side of the Southern Cross, are rapidly approaching, some with a speed of nearly 150 kilometers a second: while those on the side toward Ophiuchus or Cygnus are receding with equally high speed.

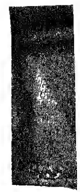
This is the most striking evidence of the galactic rotation that is so far known. It is no longer the small, though distinct, difference between the motions of bodies revolving on the same side of the center and with a good deal the same speed, but the rapid motion of bodies very much nearer the center than ourselves, like Mercury seen from the earth.

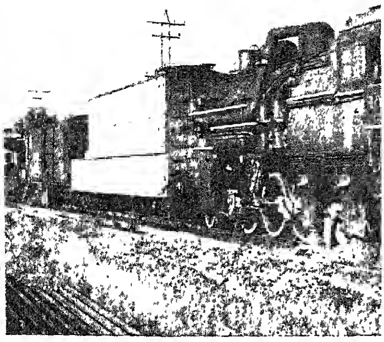
For the nearer groups of nebulæ—and for the distant ones in other parts of the heavens, the motions are also in good agreement with the predictions of theory, the effects diminishing, as, with proximity to the sun, they are washed out by the sun's own motion.

Seven small and doubtless distant nebulæ, on each side of the center, show much smaller motions than the rest, and are interpreted as bodies like *E* and *F* in Figure 1, so distant that they lie beyond the regions of rapid motion.

The whole set of results is admirably consistent, and affords the best picture of motion within the galaxy which is now available.

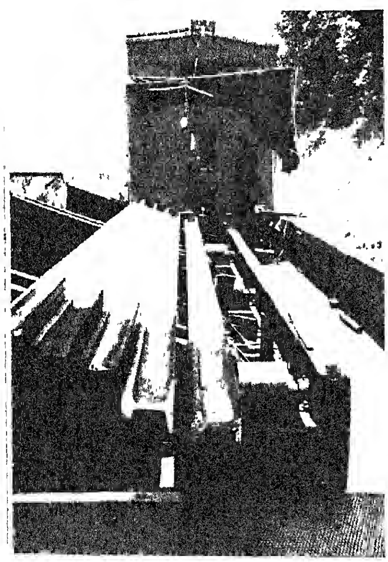
DR. BERMAN—who has discussed thoroughly many matters which must be passed over here—concludes finally that the distance from the sun to the center of the galaxy is 9400 parsecs (30,000 light-years). One revolution of the sun (and the neighboring stars in general) about this center takes 210,-000,000 years. The total mass of the galaxy comes out 230,000,000,000 times the sun's. Half this is concentrated in a region extending 3000 light-years from the center. If this is true, and the obscuring clouds could be removed, we would see a central nucleus in the Milky Way, far more conspicuous than any observable star-clouds, and no one would ever have thought that we were near the center. Dr. Berman places us two-thirds of the way out to the edge. The planetary nebulæ themselves are large affairs, with an average diameter of some 30,000 times the earth's distance from the sun, or half a light-year. The total light of a typical specimen is about 300 times that of the sun. By an unhappy chance (for us) not one of the nebulæ appears to be nearer to us than 2400 light-years. If a sample one was as near us as Arcturus or Vega. it would look nearly twice as big as the moon, and its total light would outshine either of these stars.—*Princeton University Observatory, October 4, 1937*





Years of experiment have proved the practicability
- and marked advantages of welded railroad rails in
ıng lengths. Several miles of welded track are being laid
n the Delaware & Hudson with the Sperry welding,
ınealing, and grinding mobile train unit shown above

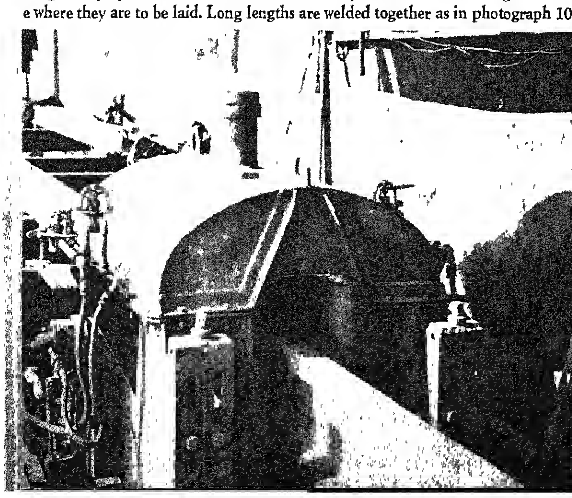
# Railroad Rails by the Mile

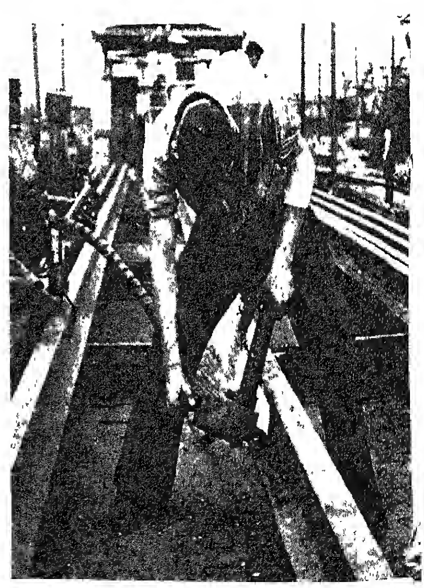


Standard 39-foot, 131-pound rails in the rack car, ready to be delivered to the welding equipment in e next car of the train, by means of power driven rollers

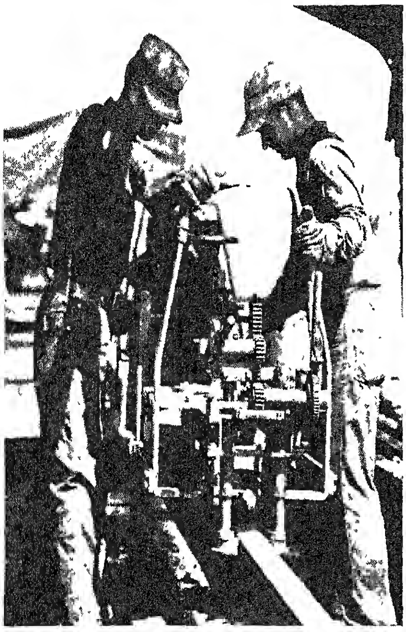
3 The ends of two rails are carefully aligned and then flash welded in the welding car of the special train. The welding machine has automatic control. Power for the Sperry Products, Inc., welding equipment is supplied by two General Electric turbine-driven generators operated by steam from the locomotive. Each weld cycle takes six minutes to complete; succeeding operations are so timed that the production of welded rails in long lengths is almost continuous

Mounted on the next car following the welding car is the stress-relieving furnace shown below. Making the weld, stress relieving, and the following grinding ›erations may be considered as forming a complete cycle. Upon completion of ch group of operations, the rail is hauled one rail's length along a string of flat rs that are attached to the rear of the train. Thus it is possible to weld rails limited length only by the number of flat cars available, and to haul these lengths to the e where they are to be laid. Long lengths are welded together as in photograph 10

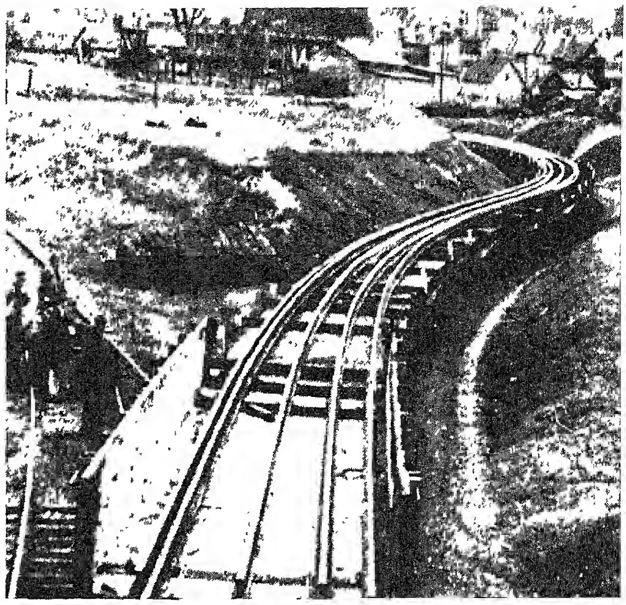




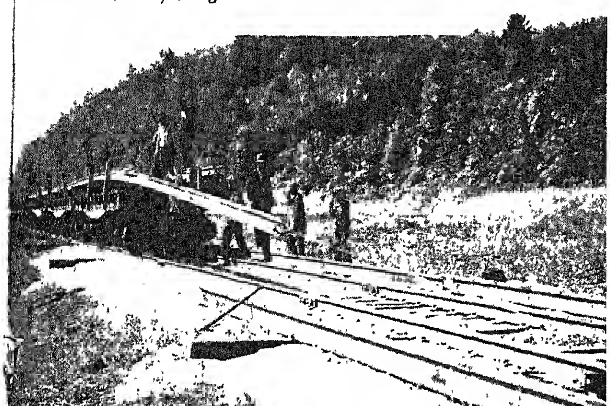
5 After the welded rails have been checked for alignment and a gage grinder has removed upset metal at the joint from the sides of the rail-head, a second grinder in the production line removes excess metal from the fillet, as shown above. A third or intermediate grinder then re-



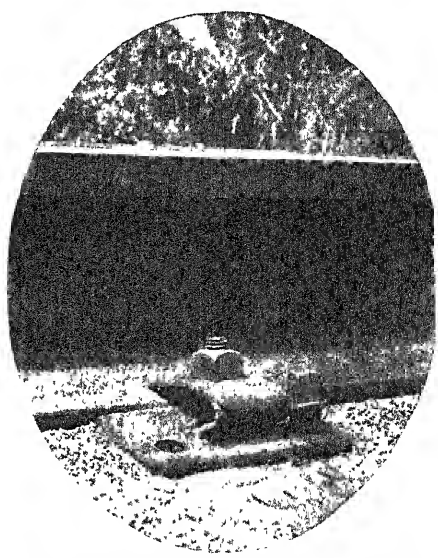
6 The fourth and final grinding. An accurately controlled abrasive block smooths and contours the rail. Welded joints eliminate the "click" of wheels passing over open joints, flattening of the rail ends which necessitates repairs, rail replacement due to excessive end wear, and give a more comfortable ride



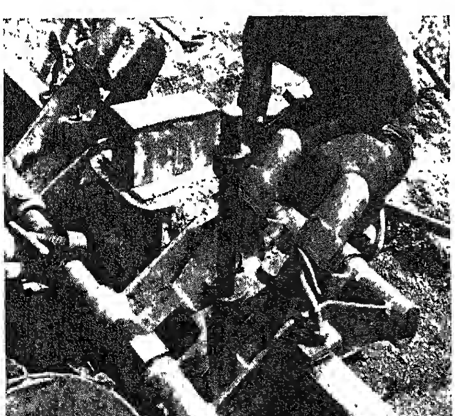
7 Welded rails in transit. When the required number of rails of a given length have been loaded on flat cars, they are dispatched to the point where they will be laid. Long lengths of rails give no difficulty when rounding curves; they bend and straighten as necessary without even being fastened to the bottoms of the cars



Unloading lengths of welded rails for distribution alongside of a track that they will eventually replace. A cable fastened to the end of one of the rails is anchored the ground and the train is hauled away. The rail thus practically "unloads itself"



9 Welded rail in track is firmly fastened to ties by spring clips, each of which exerts a pressure of 2500 pounds on the base of the rail. The resistance to movement produced by the clips and bedded ties is greater than any force of expansion or contraction in the rail. Once laid in track, therefore, welded rail remains rigid



10 Long lengths of welded rail, in position, are joined by Thermit "closure" welds. Heavy clamps hold the rail in alignment while molten metal is poured into the mold. It requires about one hour to make a Thermit closure weld

11 Welded rail in a finished track. Note absence of plates used to join conventional rails. Welded rails are laid in long lengths, broken only at intervals by the insulated joints necessitated by the usual signal circuits

# THEY SHALL NOT PASS

## Preventive Medicine, Man's Battle with the Germs of Disease . . . Toxins and Anti-toxins . . . Vaccines, Inoculations . . . Disease Is An Insult to Science

By G. H. ESTABROOKS
Professor of Psychology at Colgate University

EARLY in the 16th Century Cortez was having a terrific struggle with the Aztecs. Repulsed from Mexico City, he retired for a year with the shrewd suspicion that his task would not be as difficult in 12 months' time. He was right. In those months about half the Indian population died of smallpox—Spanish gift to the aborigines.

After the capture of Fort William Henry, as described in "The Last of the Mohicans," we hear no more of the Quebec Indians as a force in colonial wars. The reason was diphtheria, raging in the fort. The Indians had massacred part of the garrison, dug up the bodies in the grave-yard for their scalps, and from these bodies picked up diphtheria in the bargain, and carried it back to their villages. That winter was a sad one in the history of the Hurons.

During the early 1870's a terrible scourge hit the Fiji Islands, killing over half of the entire population. The dread disease turned out to be measles. Regarded—then, at least and by some even today—more or less as a joke by the white man, it is terribly fatal to primitive people, and today is probably doing more than any other one factor to exterminate the Eskimo.

THUS, the Eskimo, Indian, South Sea Islander, and other so-called "primitive" races are on their way out—and it isn't the white man's bullets that are doing the trick. Indeed, the white man cannot save these doomed peoples, for his very arrival is their death sentence. He brings with him the germs of tuberculosis, typhoid fever, and a dozen other scourges. The white man is more or less immune to these diseases, but they spell death to the "savage."

A century ago your life expectancy at birth was about 40 years. Now it has jumped to more than 60 and is still going up. Let us see why it is that your chances of living to a reasonable age are now so improved, and why we can't do very much for friend Eskimo, no matter how good our intentions.

We can summarize our statements under the head of preventive medicine, which divides itself very neatly in two sub-topics. First, we have that branch which prevents the microbe from making contact with you; then, we have another branch which thickens your skin, as it were, so that the microbe can't sink in his teeth even when he does arrive.

Most diseases are, of course, caused by germs, and our interest here centers on this group. For 100 years our best brains in biology have been chasing the microbe. Then, when they have backed his lordship into a corner with the microscope, they try to find his life story, likes and dislikes; in fact, anything which may aid in the general problem of keeping him under control. In many cases, brilliant success has attended these efforts; in others, we can't even find the bug, let alone control him; he is so small that our best microscopes pass him by. Even in these cases, however, he may have certain little idiosyncrasies which help, for your microbe is an individualist. The smallpox bug has his own way of doing things and must not be confused with the gentleman who causes scarlet fever. Both would feel deeply insulted if classed with the malaria organism, and certainly would not respond to quinine treatment.

However, all these chaps have in com-

Photo Army Medical Museum

**The germ that causes the bubonic plague in man rides on a flea that rides on a rat—an illustration of the "secondary host" compounded**

mon one point—perhaps the most important single factor in disease control—they live in what we call a "discontinuous" environment. If you get bubonic plague or typhus fever, then either the germ will kill you or you will kill the germ. There is no compromise. Whatever the result, the germ has to find another victim; he has to be continually on the move for his environment is discontinuous—and here is his greatest point of weakness. Science bends every effort toward the destruction of his lines of communications, so that he can't make the shift. Here, quarantine is, of course, one obvious line of attack. When you get diphtheria or scarlet fever, you are isolated from the rest of society, for a large number of diseases are caught by personal contact. So we try to prevent the microbe from spreading by denying him this opportunity. The ancients early hit on this idea, in handling leprosy.

BUT quarantine, in and of itself, was helpful only in certain diseases. Plagues swept humanity, and at such times isolation of the sick had no effect. Then, with the discovery of the germ theory, science hit on a new idea. Germs cause disease, and sickness is spread by these germs. But why can't the germ grow outside the human body and be spread by means of food? Such proved to be the case. Certain microbes do grow in "cultures" quite apart from the body. Milk, for example, is an excellent breeding ground. Once it is infected with, say, typhoid or tuberculosis, the germs in question multiply indefinitely, so that anyone using it stands an excellent chance of becoming diseased. So now we pasteurize our milk and have rigid laws of food inspection. In tropical countries the white man has to be even more careful of his food, since many deadly diseases travel by this method.

However, man found that quarantine and care of food by no means prevented the spread of disease. It helped in some cases but had absolutely no effect in others. So science again scratched its collective head and thought deeply. The water supply was another lead. Water could carry the germs, from the point where they grew, into the human body. So in some of our large cities we drink what often tastes like a saturated solution of chlorine, but we are then pretty certain that our water is pure. Science thus cuts the microbe's line of communi-

cation at another point. Once again it helped, but some diseases remained just as prevalent as ever.

So medicine called in all its allies to a real huddle. Germs of this, that, and the other disease skipped gaily from one human to another, without leaving the vaguest hint of how it was done. Quarantine, protection of food and purification of water had absolutely no effect. Then some real genius struck on a bright idea, tested it in the laboratory and found he was right. Science as a whole raised a whoop of joy and went to work under its great new motto—not *cherchez la femme* but *cherchez* the secondary host.

It was malaria that let the cat out of the bag. This disease was always associated with swamps. Man also observed that it occurred only in conjunction with a certain insect, the malaria mosquito. What better guess than that this particular mosquito sucked up the malaria germ from the blood of an infected human, and that the microbe then grew in the insect's body and was passed on to the next individual whom the mosquito bit? And if this was so in the case of malaria and mosquitoes, then why not in the case of other diseases and other insects?

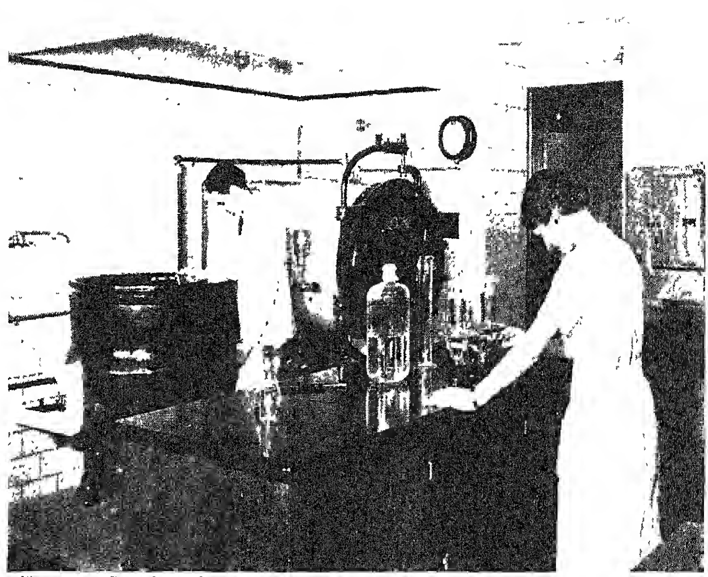


Photo courtesy Eli Lilly and Co.

**In spotless laboratories anti-toxins prepared from sleek, healthy horses are processed and made ready to combat diseases that break out without warning**

SCIENCE rolled up its sleeves and won its next round from disease in brilliant fashion. Malaria was not the only culprit which used this concealed-ball play. Yellow fever traveled by another species of mosquito, bubonic—the dreaded black death of history—rode on the rat flea, typhus came riding along on the louse, and many other diseases were found to use the so-called secondary host.

Curiously enough, there is a very clear-cut and specific relationship between any particular disease and its insect carrier—this secondary host. Malaria can travel only by means of the malaria mosquito; all other insects—even other species of mosquitoes—are powerless to spread this disease. Bubonic goes by the flea, typhus by the louse, and yellow fever by its particular brand of mosquito. So with many other diseases—they spread by their own specific means and no other. You can live in the same room as a case of typhus—not typhoid—fever with perfect safety if you haven't a louse holding the joker. If you have, the undertaker will make up the foursome. So we control these diseases by literally swatting, this time, the flea.

Then there is, also, the fly. He is one of our worst disease "carriers," even if not a secondary host. By this we mean that the disease germ does not actually enter his body and multiply, as in those former cases. Nevertheless, if the fly is continually in contact with dirt he can easily pick up very dangerous germs on his body and then spread them just by wiping his dirty feet on your food. Such we know to be the case, and the health officer of any town will always scowl his blackest scowl when he sees flies running over exposed meat or fish in a store window. For the same reason, he will swear at a cockroach and is likely to cuss mildly even at dogs or cats—not your dog or cat, of course, which are doubtlessly very clean, well kept animals, but pets in general who may track some very undesirable visitors into the house from the nearest garbage can.

Science does everything in its power to make life unbearable for the said flea and for his carrier, the rat. But fleas and rats have proverbially tough hides. They can take it. Your health officer can make the going tough, but sooner or later a flea-laden rat will elude him, and then he will have a case of bubonic on his hands. This statement applies to any type of germ disease, no matter how it is spread; that is, sanitation may hold it in check but the odd case of diphtheria, smallpox, or typhoid will crop up, in spite of all precautions.

Moreover, for all our research, there are still diseases whose tactics have us baffled. We have not the foggiest notion of how infantile paralysis gets around. Spinal meningitis still holds its secret, and sleeping sickness—not the African type—is in the same class.

So science prepared its second line of defense in preventive medicine. Man has or develops immunity to certain diseases. Could not this immunity be fostered by artificial methods? Obviously, the very best way to handle typhoid is to so treat the human that he can't contract the disease, germs or no germs. This line of attack looked pretty silly at first, but there were certain leads. If you are bitten by a dog, you're just plain bitten; but, if a smallpox bug nips you, well, maybe you are or maybe you aren't. Some people won't take smallpox, or if they do, they take it very lightly. Their hides, or something, are too tough for the microbe to have any effect. We say they have "natural immunity," the result of long centuries wherein their ancestors were exposed to the disease and all the non-resistant members killed off. Nature selected the survivors, and thus we have many cases of individuals or whole nations with natural immunity to certain diseases.

BUT there was another very common type of immunity. It was quickly noticed that, once you had certain diseases, you never took them a second time. After a dose of smallpox, you need have no further worry on that score. You were either dead or immune. So terrible was this scourge at one time that people deliberately had themselves inoculated with a mild type of the disease. It was a terribly risky procedure, for a mild case with me might be fatal to you, but it was one way of developing this "acquired" immunity, and the whole situation gave the scientist food for thought. If acquired immunity, then why not artificially acquired immunity? Here, as in the case of malaria, science followed a promising lead and many diseases have had very slim pickings ever since.

When the doctor stabs you with a hypodermic for typhoid, and gives you this third type or so-called artificially acquired immunity, he is literally fooling your body. Most microbes are themselves really very nice little fellows to whom the body has no objection, but the disease-producing power of germs

depends on certain toxins or poisons which they secrete. For any particular disease, this toxin is very specific. Now your body fights fire with fire. It manufactures an anti-toxin to neutralize this poison, just as you use an acid to offset a base. (This counter poison also, indirectly, kills the germ.) The whole course of any germ disease depends on your ability to turn out anti-toxin.

This body of yours learns fast and doesn't forget. When you have scarlet fever you learn to manufacture the anti-toxin which neutralizes and kills that microbe. From that time your body is very much on its guard. When next you are attacked by this particular germ, its arrival is a signal for the immediate manufacture of anti-toxin in such quantities that the luckless microbe is literally smothered before it can even start business.

So, in order to forestall all this, the doctor rings in a false alarm. He takes some of the toxin or poison of the disease in question, say typhoid, and injects it into your arm. Immediately there is terrific internal commotion. Your body thinks it is being attacked by the deadly typhoid germ and holds up other business to turn out typhoid anti-toxin. At weekly intervals the doctor throws in two larger doses, to keep up the illusion, and then lets nature take its course. When it is all over, your body has learned the lesson of how to manufacture typhoid anti-toxin fast and in large quantities. Should the genuine typhoid bug later arrive he just has time to get inside the door when he is taken very firmly by the scruff of his neck, thrown out and the door slammed in his face.

FINALLY, there is a fourth curious type of immunity which gives protection *after* you take the disease. We mention it here because its application depends on exactly the same principles we have just been noting. It is called "passive" immunity and is used in certain diseases, for the very good reason that we have thus far found nothing better. Nevertheless it is very effective, even if a trifle nerve racking. Diphtheria was, until lately, a case in point. We could not inoculate against this disease. Moreover, it has a very dangerous peculiarity—it is a fast worker. So rapid is the progress of diphtheria that the body has not the time to build up its own anti-toxins. Hence the very heavy diphtheria mortality up to the present century. Then medicine decided on good football tactics. Unable to hold the line, we now allow diphtheria to move right in, take possession and have things all its own way. Then the doctor uncovers his star trick play.

If you can't manufacture anti-toxin, a horse can. We inject diphtheria toxin into the animal, his body builds up anti-toxin in defense, and we keep this for use in just such cases. When the disease is at its height we assist the body by injecting this anti-toxin in such quantities that the diphtheria toxin is completely neutralized and the germs so weakened that the body can mop them up at its leisure—a very dangerous type of delayed play which works perfectly if everyone knows his business. We call it "passive" immunity because the anti-

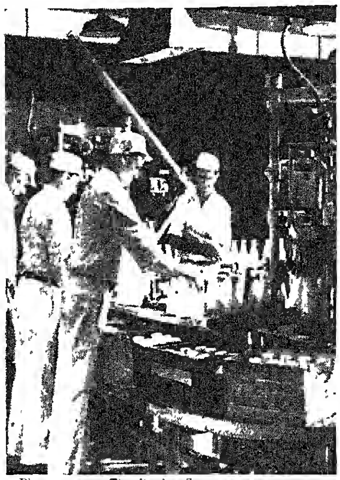


Photo courtesy The Borden Co

**Bottles being filled with pasteurized milk and routed toward the consumer, mainly freed from germs**

toxin is prepared outside the body. All you do is act as the guinea pig. We should add that medical science now has a very successful inoculation against diphtheria, a product of the last few years.

Since preventive medicine has made such strides in its struggle against disease, you very naturally wonder that sickness is still a problem. But it is, as we all know, and that for very good reasons. Every disease germ is very much of an individualist. He does things his own way. For example, you could take all the precautions mentioned up to now under the general head of disease contagion—and it wouldn't mean a thing to a hookworm. You contract that disease by walking barefoot over infected ground. This animal burrows in through the skin of your foot, taxis around through the blood stream and finally lands in the digestive tract—just his way of doing things.

We haven't the slightest idea how some other diseases spread. Many a research man would literally give his right arm if he could just find a clue as to how infantile paralysis gets around. That might be the first step towards its control—and it might not. But at least we would have something to work on.

Then there are certain diseases to which you won't develop immunity, even after you have had them. The common cold is a notorious example. German measles is another. For some reason or other, which is still very obscure, the body cannot learn to build anti-toxins rapidly enough to check these ailments.

Other disease germs have certain peculiarities which make the manufacture of vaccines impossible. Tuberculosis is an excellent example. This germ is easily seen under the microscope, will grow outside the human body, and has been the "microbe guinea pig" for 75 years. Here we are pretty much where we started. Either it won't, the body won't, or something won't. We can't seem to get a vaccine which protects against tuberculosis, and the "white plague" is still treated by sunshine, fresh air, and rest.

WE are more or less chasing the microbe into his own back yard and cornering him. The development of better microscopes is helping. Up to lately we could magnify an object 2000 times, which was not bad. Now we can raise the ante to 3000 times, which is better. It helps if you can see the little devils; but many are too small to find, even with the very best of microscopes. Then, again, it improves the situation if you can farm them out, as it were. If you wish to learn the tricks of microbes, then you need microbes to play with. Some will live only in the human body, dying almost instantly when they leave it. Others can be bred in test tubes and examined at leisure. This helps. Some of our most careful research has been aimed at developing a diet on which, say, infantile paralysis would live outside the body. We have failed here but had brilliant success with other germs. And we are making very definite progress.

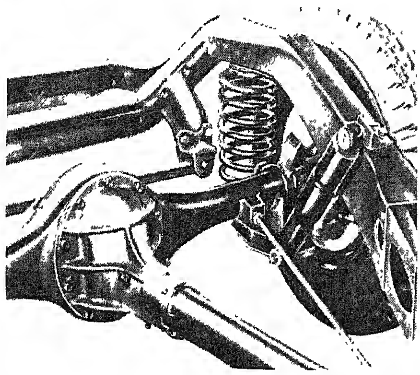
The existence of contagious disease is an insult to science. We haven't the brains to outwit a little germ so small that even the best microscope can't find him. But we are making the going tough. Your local health officer and the state department have him worried. Just a little more co-operation from everyone and we may have many a germ stuffed and mounted in our microscope museum as "the last specimen of the now extinct species *Diphtheriens omnivorens*, trapped attempting to leave this planet for Mars."

Let us close with an appeal for co-operation. We are living in a country which stresses individual freedom. If I don't like vaccination, I can say so. It is my privilege to tell the local health officer he is a chump, or to spend a million to combat vivisection. No one compels me to drink pasteurized milk, while in food matters the only real policeman is the stomach-ache. This is all as it should be.

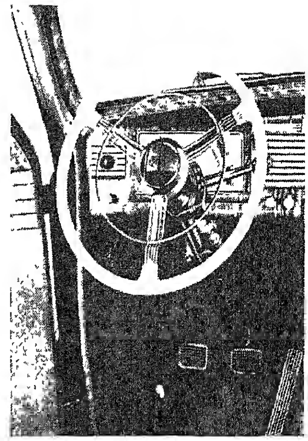
But you can't bluff a bug. My well-intentioned ignorance may start a typhoid epidemic or hold up research on sleeping sickness. Your health officer, like the Mississippi levee, stands between you and disaster.

# ON YOUR 1938 CAR

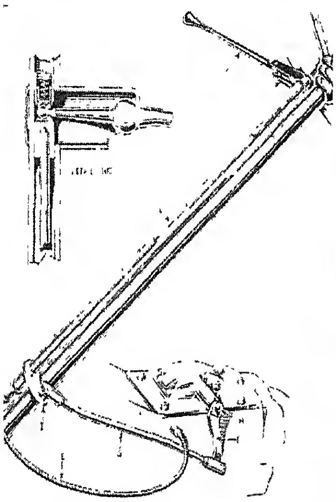
In many of the new cars being brought out this winter, designers have gone to great lengths to eliminate obstructions from the front compartment and to increase driving convenience. For example, the parking brake lever on the new Dodge is located directly under the center of the instrument panel



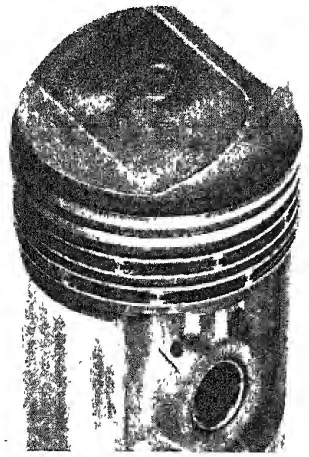
Coil-spring rear suspension is being pioneered by Buick for 1938. Improved riding and steering qualities are claimed. Photograph shows spring and airplane-type shock absorber at left rear wheel



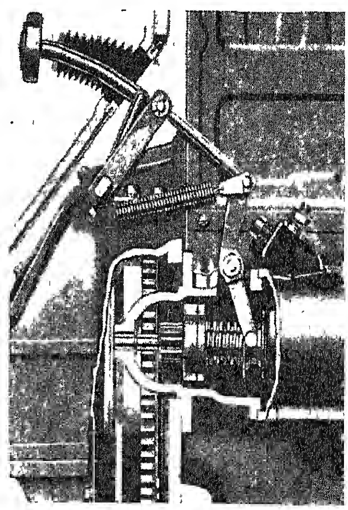
Automatic and semi-automatic transmissions are featured on many of the new cars. In the Buick self-shifting transmission a four-speed planetary system automatically provides the correct gear ratio needed. A lever under the steering wheel selects neutral, reverse, or forward



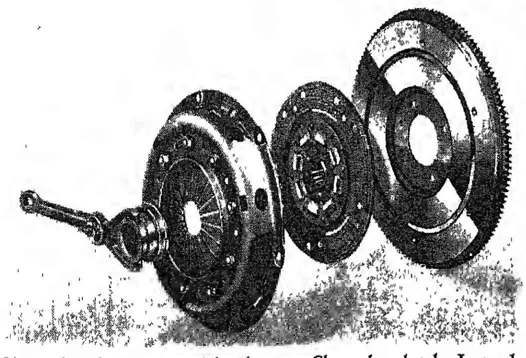
The Pontiac remote-control gear shift eliminates the lever from the front floor and places it under the steering wheel. Here it is operated in the familiar "H" pattern, except that the "H" is on its side instead of flat. The lever under the wheel is linked to the transmission through a movable rod which is held parallel with the steering column. The clutch pedal is used in the same manner as with the conventional gear shift



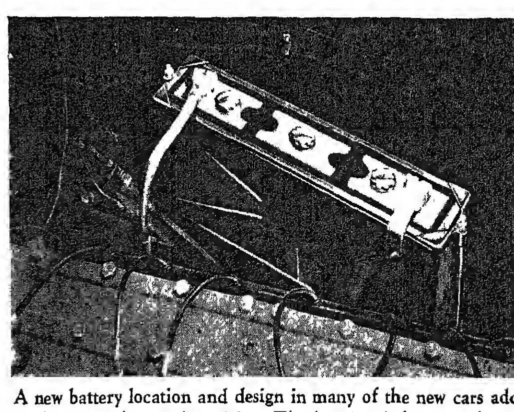
The new dome-shaped "turbulator" piston used in the 1938 Buick engines. It is claimed that the shape of the piston-head controls combustion and permits the use of a higher compression in the engine without detonation and without the use of so-called "premium" fuels



In the new starting mechanism used by Chevrolet, the starting motor is connected to the starting pinion through an over-running clutch. The pinion is mechanically meshed with the fly-wheel gear before the switch on the motor is closed. The photograph shows the pinion disengaged. As the pedal is depressed the linkage moves the pinion into mesh. The same linkage then closes the motor switch and the starting action takes place



No coil springs are used in the new Chevrolet clutch. Instead, a spring-steel diaphragm with 18 fingers bears against the pressure plate, providing even distribution of the driving load



A new battery location and design in many of the new cars adds to the convenience of servicing. The location is between the engine and the side of the hood, as in the Pontiac illustrated

# THE NEW HEAVY NITROGEN

## Science is Enthused about Some of the Significant Problems which Urey's Achievement Promises to Unravel . . . Opportunities that Surpass its Dreams

By BARCLAY MOON NEWMAN

HEAVY nitrogen with which to label molecules is at hand. A first step has been taken toward tracking the paths and detecting the nature of the dance of invisible particles whose rhythm makes possible the visible phenomena of life—the growing body, the thoughtful brain, the birth of offspring, the upward surge of evolution, the aging that ends lethally. What big advances are to come?

Nitrogen's many rôles in the living thing are of the most profound significance. Amid all the stupefying diversity of earthly life, there exists no form which can dispense with this element. The basic threads out of which all life fabric, every animate shape, is woven are the nitrogen-containing proteins—albumin of egg-white, casein of milk, gliadin of wheat, myosin of lean meat. The center of life-control, the nucleus within every living cell, is rich in protein—therefore in nitrogen. And yet nitrogen remains among the least understood of protoplasm's vital elements.

Now, however, heavy atoms of nitrogen can be used as tags or labels by which to distinguish certain molecules from others of the same kind found in the body. By such tags, molecules can be traced even into the most obscure of life's laboratories within the tissues, and the fate of nutrients and other significant life materials can be brought to light.

THE tag of heavy nitrogen can be attached to the tiny bits, the amino acids, which the organism strings together to make into giant protein molecules. The comings and goings of these bits, how they are strung together into huge particles, what the destiny of these great molecules in the life mechanism, and how the amino acids and their great synthesis, the proteins, co-operate with other important materials—of such fascinating leads to the solution of life's secrets the elucidation has begun.

Besides these long-baffling general problems of the construction and fundamental modes of action of proteins, there are countless special problems of equal interest. Vitamin B, the "nerve vitamin," which prevents the paralysis of beriberi, has nitrogen as a constituent. What is the precise manner of action of this strange compound, essential to existence yet present in remarkably minute quantities? The answer, gained perhaps by the aid of heavy nitrogen as an indicator, should permit bio-scientists to pierce deep into the misty realm of the nervous system, and even beyond, because plants and microbes as well as the higher animals draw a portion of their vitality from Vitamin B.

Unique among live beings, lowly organisms such as the bacteria in the roots of clover, take free nitrogen from the air and fix it to other elements, to give rise to nitrates—valuable in fertilizers and explosives. May not heavy nitrogen teach man how to manufacture nitrates cheaply and efficiently after the way of the nitrogen-fixing bacteria?

Prof. Harold C. Urey, of Columbia University, Nobel Chemistry Prize winner, discoverer of heavy water and, recently, of heavy nitrogen

Chlorophyll, the pigment which gives greenness to vegetation, makes possible a more important synthesis, photosynthesis, the production of sugars and starches from the soil water and the carbon dioxide of the air, sunlight being the source of energy. Chlorophyll is believed to be the chief enigma in this utilization of sunlight—the storing of light-energy in foods which are practically the sole source of fuel for the world of life. It is now an old dream of the scientist, that he might emulate the green leaf and turn light, water, and part of the air into foods and carbon compounds, both edible oils and fuel oils, and innumerable by-products—again cheaply, and with high efficiency. Coal and oil deposits are traced to ancient photosynthesis. Nitrogen is a component of chlorophyll too, and a significant component. Heavy nitrogen will help realize this dream—though surely not soon, since photosynthesis is among the most complex of animate phenomena.

ONE of the most startling conceptions in the entire history, the entire universe, of science is steadily becoming more firmly established as fact. This conception is of molecules, made like all molecules out of atoms, of course always inanimate, but molecules which can induce the formation of duplicates of themselves out of the surrounding medium, if it is of suitable composition. These molecules are the units that make up chromatin, the material which is the controlling machinery of inheritance—material present in the nucleus of every cell, material assuring that the offspring will be closely similar to its parents. Chiefly because of its chromatin, the hen's egg develops into the chick, which shows species and family resemblance. And the egg arises from a cell within the hen's reproductive organs by a process in which the cell's chromatin makes a copy of itself, handing this duplicate machinery of inheritance to the egg. In order that such a copy may be made, the chromatin's units, or genes, separately or together—and perhaps assisted by the surrounding medium—construct new units like unto themselves. These molecules, intricate and giant, become linked in fragile threads—the chromatin. Since these automatically reproducing particles are protein, nitrogen is involved in a major way. Heavy nitrogen provides new hope that more definite understanding of heredity's astonishing molecules may be forthcoming in the not too distant future.

Heavy nitrogen in concentrated form is the recent epochal achievement of

Dr. Harold C. Urey, professor of chemistry at Columbia University, who was awarded the 1934 Nobel Prize in chemistry for his discovery of heavy water. This achievement is epochal because it brings to experimental medicine and to all seekers of life's secrets a new and invaluable tool of research.

In 1935, Dr. Urey suggested that nitrogen's two varieties—light and heavy atoms—could be separated by the chemical process which he has now brought nearer perfection. The problem was surpassingly difficult, since the two kinds of atoms are almost identical in both physical and chemical properties. And the difference between the weights of the pair is so slight as at first sight to appear meaningless.

THIS unthinkably tiny difference may be simply expressed, however. When the weight of an atom of light hydrogen is taken as 1, then a heavy hydrogen atom—a deuterium atom—weighs 2. On this scale, the weight of a light nitrogen atom is 14, while that of a heavy nitrogen atom is 15. And here we may recall that when we take a breath of air—of which four fifths is nitrogen—we are inspiring atoms of light nitrogen mixed with traces of heavy, but both in trillions so numerous as to defy our mental grasp. Yet scientists have in the last few years learned that upon such wondrously small particles nature's biggest mysteries are founded.

Also upon such minutiae Dr. Urey has built his success, for his process of separation depends upon the almost insignificantly greater weight of the heavy nitrogen. He uses a tube, six inches in diameter and 35 feet high. Twelve hundred small steel plates, arranged in a column, extend up through the tube, and over these a solution of ammonium sulfate is allowed to drip down. This compound, best known as a constituent of fertilizers, contains both light and heavy nitrogen atoms. By chemical reaction at the bottom of the tube, the ammonium sulfate is made to yield up its nitrogen in the form of ammonia, some of which remains dissolved in the solution below and some of which rises, as a gas, through the tube.

The ammonia molecules of the gas are taken up by the down-dripping solution, from which they displace other ammonia molecules—which, of course, are part of the larger molecules, the ammonium sulfate. But the ammonia molecules with the light nitrogen tend to remain in the gas, while the ammonia molecules with the heavy nitrogen go more rapidly into the solution. Thus, heavy nitrogen is increasingly concentrated in the ammonium sulfate solution at the bottom. When this solution is drawn off, the heavy nitrogen is obtained in concentrations of the order of two and one-half percent—as against the few atoms of this variety normally found mixed with the far more abundant light atoms. By this means, the equivalent of about two fifths of a pint of heavy nitrogen gas per day is obtained. The process is slow, the cost high.

Nevertheless, this separation of nitrogen's two variants, though only partial, does provide bio-chemists with enough heavy atoms for extensive and highly meaningful experimentation. Already some of Dr. Urey's heavy nitrogen, in the hands of Dr. Rudolf Schoenheimer,

**Dr. Urey (left) and Dr. John R. Huffman with the 35-foot column by which the heavy isotope of nitrogen was separated in quite sizable quantities for the first time**

Columbia bio-chemist, and his co-worker, Dr. David Rittenberg, has brought new information about chemical activities within the animal body.

In a preliminary experiment, Dr. Schoenheimer tested the possibilities of heavy nitrogen as an indicator. He synthesized the substance glycine, using heavy nitrogen instead of light nitrogen. Glycine is one of the amino acids—the building blocks of proteins' molecular architecture—and occurs in proteins throughout the organic world. The heavy atoms later identified the glycine molecules so produced.

Next, our bio-chemist combined his tagged glycine with benzoic acid—a chemical sometimes used in tiny quantities for the preservation of food, and a component of many a complex compound which plays a life rôle or which is a waste thrown off in vital reactions. This combination made a bigger molecule: hippuric acid, one of these waste products. He fed this labeled acid to rats. When he was able to discover heavy nitrogen in hippuric acid disposed of by the rats' kidneys, he could be sure that his tagged acid had been absorbed through the walls of the intestine, transported by the blood to the kidneys and there excreted. Hence, for the first time, a nitrogen-containing molecule had been traced through the body by the use of nitrogen 15 as a tag.

In the same series of experiments, Dr. Schoenheimer solved a bio-chemical puzzle. Benzoic acid is set free as a necessary but toxic side issue from life chemistry within the cells. It is rendered harmless by yoking glycine to it, and the hippuric acid so formed is readily removed. Now glycine is a part of almost all proteins wherever occurring. Bio-chemists have wanted to know whether, in order to yoke glycine and benzoic acid into hippuric acid, protoplasm must turn to a glycine-containing protein to get the needed glycine; or whether protoplasm could merely use any available, free glycine that might be present.

FREE glycine and free benzoic acid were injected separately into the blood stream, and the kidneys excreted hippuric acid which must have been synthesized from the glycine injected—for this glycine was labeled with heavy nitrogen. It is to be concluded, therefore, that glycine can be directly utilized in the formation of hippuric acid; the amino does not have to be taken from a glycine-containing protein.

Drs. Urey and Schoenheimer determine the presence and the concentration of heavy nitrogen by means of the mass spectrometer, a device in which a powerful magnet is used to separate heavy atoms from light atoms after they have been bombarded and electrified—that is, ionized—by a stream of electrons. The mass spectrometer can detect, identify, and even measure as little as a hundredth of a millionth of an ounce. It can indicate a 1 percent increase in the ratio of heavy to light nitrogen—an increase, in the weight of nitrogen, of one part in 300,000. Dr. Urey's mass spectrometer is shown in one of the illustrations.

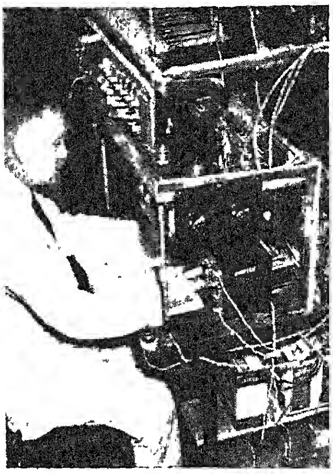
The continued increase in bio-knowledge through the use of heavy hydrogen (deuterium) strengthens the belief in heavy nitrogen's future as an instrument of research. Dr. Schoenheimer, by aid of deuterium, has lately been carrying on very successful investigations of the ways in which animals treat fats. All fats are constructed of carbon, hydrogen, and oxygen. Hence he was able to label fat-molecules by replacing part of their hydrogen with deuterium—and so could keep track of these molecules in the bodies of experimental animals, such as mice. So too he was able to set forth something of the history of fats within the human body, since the physiologies of mice and men are essentially the same. He showed that animals can convert oils into fats which do not so readily melt, that is, into solid fats; and can also, if need be, reverse the process and

transform solid fats into oily fats. Tagged molecules gave the first actual proof of this suspected ability of the animal machine.

Of still greater scientific interest is Dr. Schoenheimer's demonstration that the turnover of fats and compounds derived from them is much more rapid than has been suspected. In mice, and presumably in men, stored fat is removed and replaced every few days—even if no fat is eaten, and must be synthesized by the tissues from sugar and protein. The living body has always been conceived of as constantly active, yet it had been assumed that at least stored materials are seldom disturbed. Now we realize through research with tagged molecules that few, if any, body components remain intact for very long. Life's processes seethe even through the parts of the organism which appear most inactive and most durable.

Unfortunately, much of Dr. Schoenheimer's work, so accurately carried out and by him so conservatively reported to the American Chemical Society, has been widely and grossly misinterpreted to the public through both daily newspapers and weekly magazines. In the course of his experiments, Dr. Schoenheimer noted—as many another investigator before him—that the simpler fuel nutrients, such as oils made up of small molecules, and also butyric acid present in butter, are burned by the body far more speedily than are fats made up of big, complex molecules. Immediately the public was falsely informed, by reporters and editors who did not consult Dr. Schoenheimer, that since butyric acid is found in butter, and is rapidly burned, one could eat butter without fear of putting on weight. Immediately, too, it was assumed that all diets could go into the discard. This broadcasting of misinformation is traceable to neglect of two facts. First, the body may burn certain nutrients more rapidly than others, but any nutrient, if taken in excess of the body's needs, may be stored. And, second, the greater the quantity of light-weight molecules eaten, the greater the quantity of the heavy-weight molecules which is stored as reserve fat: hence butter is a ready means to increase in buxomness.

VARIETIES, or isotopes, of elements that are important to life may be used as indicators of life's secrets because protoplasm apparently treats tagged molecules and the corresponding untagged molecules alike—provided the isotopes are not supplied in concentrations much higher than those to which the organism is normally accustomed. On the other hand, concentrated heavy water, water consisting of ordinary oxygen and the double-weight hydrogen (now called deuterium), has proved toxic at least to certain forms of life, such as tadpoles and the slipper-animalcule, paramecium, microscopic inhabitant of ponds and streams. Biologists thus taught chemists and physicists a thing or two. Varieties of the same element do make a vital difference to life's systems—when these isotopes are present in high concentrations. Once emphasizing physical properties almost to the complete exclusion of all other characteristics, physicists and chemists



The mass spectrometer Dr. Urey uses in determining presence and concentration of heavy nitrogen

have been shown that the other characteristics are sometimes, if not invariably, highly significant in the study of an element's nearly indistinguishable variants. What heavy nitrogen, as opposed to the common mixture of light and heavy atoms, means to the live thing only experimentation will make clear. Perhaps heavy nitrogen will find its place in the production of new drugs, less poisonous to the human body than present ones having mostly light nitrogen, but more potent as heart stimulants, antiseptics, or anesthetics. It may be that vitamin B, made with heavy nitrogen alone, will be found more beneficial, or perhaps toxic, to the body as against vitamin B as we obtain it today. The delicacy of protoplasm is beyond the imagination. We can rest convinced that heavy nitrogen is going to have distinctive effects, however unguessable these effects are now.

Still, bio-chemists most familiar with such considerations believe that, however delicate life chemistry is, it is going to be only insignificantly affected by such comparatively small numbers of heavy atoms as would be introduced into the body in drug molecules. Heavy water, unless in high concentration, apparently is without effect upon the organism. The really valuable researches at present are those in which isotopes are used as labels rather than as modifiers of life activity.

Investigators along such lines are also turning their attention to varieties of potassium, another vital element, a regulator of heart beat and a participator in the basic life phenomena of practically all animals and plants. Potassium has three variants, atoms of weights 39, 40, 41. Atom 40 is the rarest but by far the most interesting. It is the only atom which is at the same time essential to life and, like radium, radioactive; for, potassium 40 emits penetrating rays, *beta* rays, consisting of negative particles of electricity, or electrons, traveling at high speed.

WHAT relation has this radioactivity to the existence of animate beings? Speculation on this score has been great. But the actual known facts are very few and as yet unrelated because so recently found. The radioactive variety has been found in unusually low concentration in portions of the heart—that is, in concentrations below those in other parts of the body, other plants and animals, and the sea. On the other hand, bone marrow, where red blood cells are formed, is relatively richer in the radioactive variety. Seaweed, too, concentrates radioactive potassium—the ratio of potassium 40 to potassium 39 is greater in seaweed's potassium than in the case of the potassium of the surrounding water. What is the meaning of life's selective action upon potassium isotopes? Thus far, no one can guess. We must wait for the results of research under way. And we can be eager for these results, because the very bases of animate existence may be concerned.

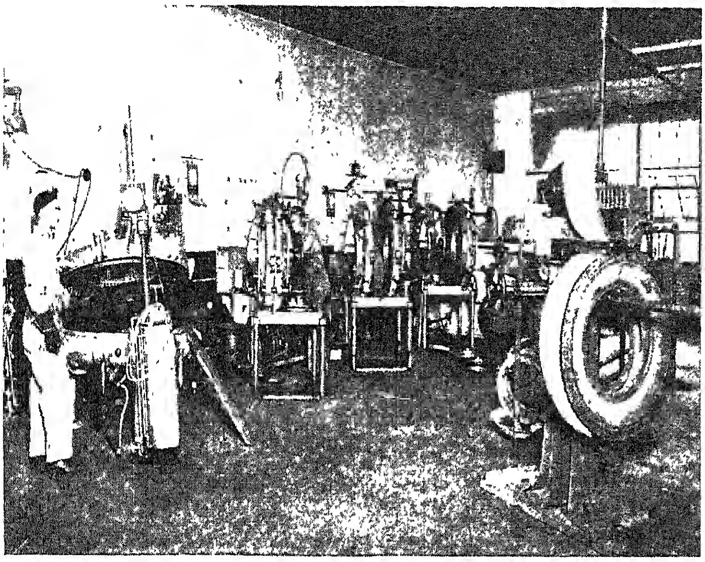
Though radioactive potassium 40 is the only essential or life element which is naturally radioactive, it is only one of a number of radioactive substances used in modern biological work. Not only are heavy atoms used as tags for molecules involved in life processes, but also life elements are being made into labels—by bombardment until they are artificially radioactive. Bombardment is done with streams of particles emerging from atom-smashing devices, such as the cyclotron of E. O. Lawrence. Thus, ordinary or non-radioactive phosphorus atoms can be derived as unstable atoms which spontaneously burst, giving off readily detectable rays. These rays are detected by a photoelectric cell connected with an amplifier; the sensitive metal of the photoelectric cell, struck by the rays, sets up minute electric currents and the amplifier steps them up so as to be easily observable. Such artificial radioactivity does not last very long, only minutes or hours, but is lasting enough to permit of its use in experimentation.

Sulfur can be bombarded and so transmuted into artificially radioactive phosphorus. The phosphorus atoms are combined to form the mineral nutrient, sodium phosphate, which is then fed to rats. After some hours, in which absorption

*(Please turn to page 380)*

# NEW TIRES FOR OLD

## Retreading and Re-Capping . . . Carcasses Must Be Sound . . . Four Out of Five . . . Of Greatest Value When Cars and Trucks Are in Constant Service



**A typical automobile tire retreading plant equipped with a full line of molds to rebuild all sizes of motor car and truck tires and thus double their mileage life**

By PHILIP H. SMITH

LAST year over 4,000,000 automobile tires were retreaded to carve away about 13 percent of the new-tire replacement market, yet this business, which seems to promise attractive economies for the American motorist, is one of the least known and least understood in the country.

Retreading is a depression phenomenon—a Topsy-like growth, apparently shrouded in a good deal of mystery. It involves nothing more nor less than replacing with new live rubber the tread which has become worn smooth under the abrasive action of the road. The only real mystery involved is why more people do not avail themselves of the practice and why so little is said about it.

The retreading process of prolonging tire life can lay no claim to newness. Tire manufacturers have practiced it for at least ten years, but they confined it to tires used by bus and taxicab companies which operate whole fleets of vehicles and buy their rubber on a strictly mileage-delivered basis. It took the depression, with its call for travel at rock-bottom cost, coupled with certain technical developments, to bring retreading forward as a mass consumer proposition of more than limited importance.

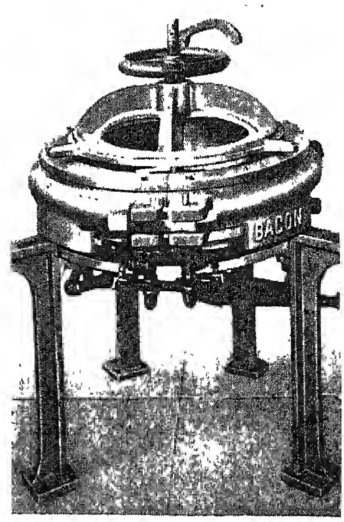
Very strangely, it was improvement in tire construction that made retreading practical. The present-day tire is a masterpiece of rubber engineering, as anyone must admit if the product of earlier days is recalled. Its foundation, the fabric carcass, is so excellent that it outlasts the tread two to one. The carcass has to be strong for, whereas the motorist can comprehend the wearing down of the rubber tread, he regards sudden failure of the carcass as evidence of defective workmanship. Tread wear is faster (relative to the fabric) than it used to be in the days of the high-pressure cord tire, in spite of all advances in the art of compounding rubber to increase durability. This is traceable directly to the decrease in wheel and tire diameters, which means more revolutions per mile of travel, and it follows also from faster driving and quicker deceleration.

The technical advance which made retreading feasible was the development of the full-circle mold which permitted vulcanization of the new tread over the whole circumference of the tire instead of sectionally, as practiced hitherto. Then some enterprising people, located principally on the west coast, opened up retreading establishments and invited the consumer to enter.

He entered because he had little money in his pocket and any economy had strong appeal. Retreading captured California and then spread eastward. Today the business comprises many manufacturers of equipment, independent producers of Camelback (tread material), patches, cements, and all the accessories required by the process, and thousands of retreaders, some devoting all their energies to rebuilding tires, others devoting part time to it and the rest to selling new tires; and, last but by no means least important, there are retreading stations which are operated by the tire manufacturers.

MANY prophesied that retreading would shrink back to insignificance when prosperity returned. Retreading tires is like re-soling shoes, they said, and the public will prefer the new product when it has an income. But the business continued to flourish. What they did not foresee was a rise in tire prices reflecting higher material costs, which maintained the spread between new tire and retread prices.

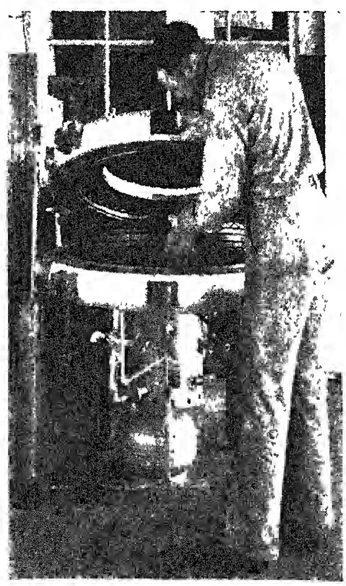
Now, you may ask, as nearly everybody does when the subject of retreading is aired: "If retreading is successful, why don't we hear more about it?" To which the immediate answer can be given that it is and it isn't, and the rest of this article will be devoted to explaining away the paradox, or, in the vernacular, "to putting you wise."




**A re-capping mold in which vulcanizing heat is applied to the tread alone, and not to the entire carcass**




Stages in the process of retreading an automobile tire. *Left:* Inspecting the carcass. *Upper left:* Buffing off the old tread down to the fabric. *Above:* Applying cement to the casing. *Upper right:* Putting on the Camelback or new rubber tread. *Right:* Rolling the Camelback to expel air and insure all-over bond. *Below:* Removing the rebuilt tire from the circular retreading mold

Retreading is beset with many pitfalls both technical and commercial. Not all tires can be retreaded—successfully, that is—and deliver a mileage that warrants the outlay. The carcass or fabric foundation must be in good condition, without cuts or breaks. It pays no better to retread a poor automobile tire than it does to re-sole a pair of shoes when the uppers are cracked. In both cases the condition depends upon the care with which the owner travels. If a motorist subjects his tires to overloading or under-inflation, or bumps into curbstones, he might as well forget retreading. By the law of averages this reduces the number of tires fit to undergo the process to a maximum of four out of five.

Another limitation is that imposed by age. Heat, light, and moisture deteriorate rubber and if a tire has not been worn to a state where it is ready for the retreading within three years of purchase, it is wiser to buy a new tire than to superimpose a good tread upon a questionable carcass. This limitation means that retreading is of little value to the motorist who drives only 8000 to 10,000 miles a year, and, conversely, is of greatest value to the owners of vehicles which are kept in constant service.

When a tire succeeds in passing the specifications of soundness, it can be retreaded so that it will give anywhere from 80 to 125 percent of its original mileage. The process is as follows:

Whatever rubber remains on the tread is removed by buffing down to a point where the fabric carcass is exposed to view. The breaker strip and cushion, which are an essential part of construction, are removed and the carcass is then placed in a drying room where it is kept for 12 to 36 hours in a temperature of about 120 degrees, Fahrenheit. After all moisture has been removed, a new cushion and breaker strip are cemented on and allowed to dry, following which the new tread, or Camelback, is affixed and the tire is slid into the clam-shell mold for vulcanization. When the curing process is completed and the tire is taken from the mold, it will sport a non-skid design and to all outward appearance it will be new.

Whether the renewed tire gives the motorist 80 or 125 percent of its original mileage, depends upon the skill exercised in carrying out the retreading process and upon the quality of the materials used—assuming, of course, that inspection revealed the carcass to be flawless. Here is where another hazard creeps in.

It isn't possible always to detect flaws in a carcass, although experience trains men to do an excellent job. A much greater hazard exists in the incompetence of retreaders and in their lack of equipment adequate to do first-class work. The business is still flooded with "gyps" whose main interest is to dress up old tires and pass them on to the consumer rather than to conserve and dispense mileage. This is the bane of the business and one that will take much

time to eradicate. Finding the reliable retreader, therefore, is only one of the many steps to be taken to get satisfaction from retreading, but reliable men are to be found.

The test of the retread is in the mileage it delivers. Promises, guarantees, and attractive show windows are not absolute guides to good workmanship. Some of the dirtiest shops do the best work; some of the most attractive stations deal in the poorest wares. But this is slowly changing to give the outward signs real significance. Retreading is rapidly losing its salvage reputation, to enter into the class of legitimate service business.

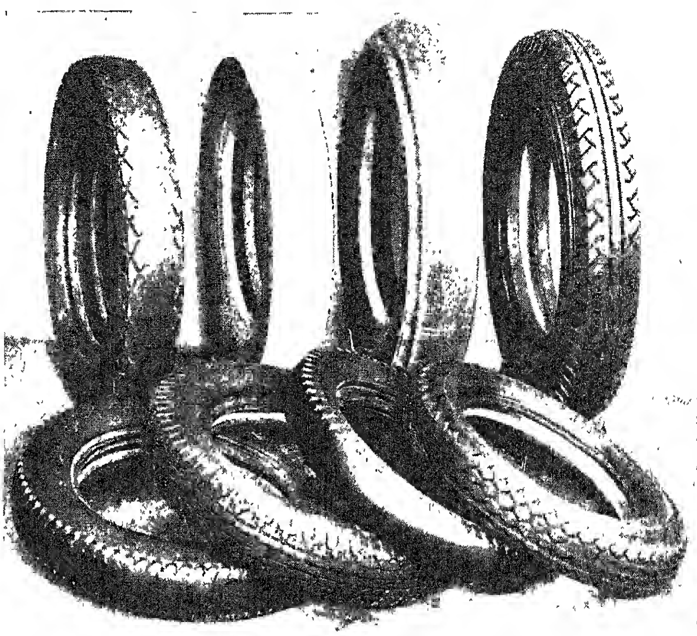
At this point the question will arise: "Aren't retreads dangerous?" It takes only one failure to create a lasting impression of hazard, but one failure doesn't tell the story. A good retread is much safer than a tire that lacks its non-skid surface or is worn through to the fabric; a poor retread is dangerous mainly because of the unwarranted reliance placed upon it. Ambulances, fire departments, buses, and hundreds of other services in which reliability is essential, make use of retread tires. Even the motorist who decries their use is likely to ride on them with serenity if he travels by bus or taxi.

In the main there are two classes of users. The first group comprises the same type of consumer who has his shoes re-soled until the uppers are gone. The second group comprises operators of great fleets of vehicles where tire costs are a big item and small economies accumulate to make the difference between profit and loss in operation. It is from these fleet operators who keep records that the figures of 80 to 125 percent of original mileage are obtained, and it is from them again that the possibilities of savings are to be garnered.

If we assume that four out of five tires can be retreaded and that 100 percent repeat mileage can be had, the possible savings incident to retreading run from 30 to 50 percent of new tire cost. No closer approximation can be made, because of the variation in tire prices and charges for retreading. Much depends upon the driver's care of his tires, and drivers are notoriously careless.

Within the past few years another practice has developed which is part and parcel of the tire rebuilding business. The practice is called re-capping and is similar to retreading, but there is this difference: not all the rubber tread is buffed off, nor are breaker strips and cushions removed. The new tread rubber is vulcanized to the old rubber tread and shoulders, rather than to the fabric of the carcass. Obviously, tires which have been worn down to the fabric cannot be re-capped.

The relative merit and demerit of re-capping and retreading are now being



All photographs courtesy *Rebuilt Tire Journal*

***Top row, left to right:*** **Worn tire, old tread removed, new tread applied, and the rebuilt product.** ***Bottom row:*** **Two good examples of before and after retreading**

aired in raging controversy and it is too early to garner any residual fact. The proponents of re-capping declare that a better bond can be had in vulcanizing rubber to rubber; that the process can be repeated many times to give much longer service than retreading, which most will agree can be performed only once. They also maintain that life is prolonged by virtue of the fact that the heat of vulcanization does not penetrate to the fabric or the sidewalls and that leaving breaker strip and cushion intact means less interference with the basic engineering design.

Opponents of re-capping declare that tread rubber must be removed in order to discover fabric separation and disintegration, and that re-capping permits concealment of defects to be revealed later by failure on the road.

Both retreading and re-capping are being done successfully and it is quite probable that both will end up in serving distinct fields. Perhaps the best carcasses will be re-capped and the more worn ones will be retreaded. Re-capping is attractive because the process requires less material than retreading.

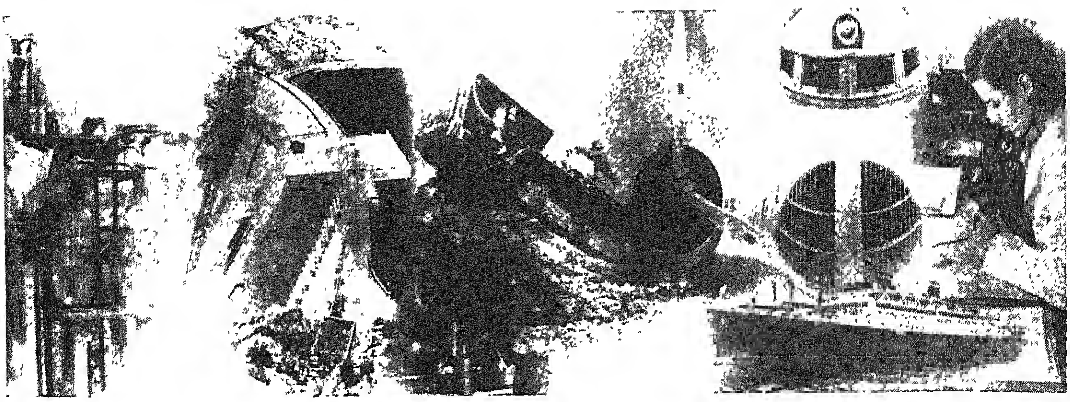
What has been said so far will explain the paradox that retreading both works and doesn't work. A little more must be said to explain why more is not heard about the practice—why it seems to remain little more than a name to the average motorist.

More people are interested in seeing retreading fail than wish it to prosper. The more it succeeds, the more it becomes known, the fewer the sales of new tires; and, as everyone knows, there is a vast organization predicated upon a continuance and expansion of the tire business. Those who are most anxious to see retreading go forward are not financed to push it and word-of-mouth remains almost the sole promotional activity.

ACTUALLY, retreading seems not the calamity that some tire manufacturers envisage, nor yet the millennium that some motorists hope. Its possible expansion can be calculated with some measure of accuracy and that maximum is many years off. Probably under the most ideal conditions retreading could never exceed 50 percent of the total replacement tire production of any given year, and this ultimate point, as well as the rate of approach, depends in large measure upon the integrity of retreaders and their adherence to high standards.

Certainly some readjustments will have to be undergone in crude and reclaimed rubber markets as well as in tire output if and when retreading approaches its full potentialities. Every retread cuts rubber consumption by about six pounds and the sum total could be impressive. We can set it roughly at 80,000,000 pounds annually.

Predictions in this business are highly speculative, but they may still have some value. For example, let us consider possible alternatives. Cheapening the fabric to balance with tread life is unthinkable. It is much more likely that some means will be found to increase tread life; but, of course, this would merely supplant retreading and would have just as profound an effect upon rubber consumption and tire output. Finally, we have no idea what research with rubber substitutes may lead to. Word has come from abroad that buses equipped with synthetic rubber tires have traveled six times the miles formerly covered with natural rubber ones. Perhaps retreading is serving merely as a transitional step in a changing rubber world.



# THE SCIENTIFIC AMERICAN DIGEST

Conducted by F. D. McHUGH

Contributing Editors

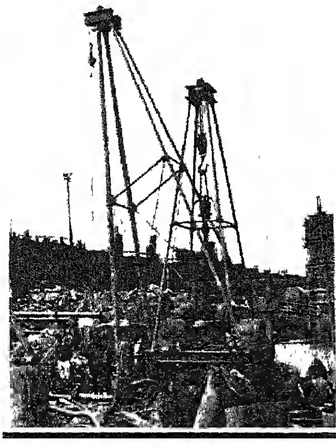
ALEXANDER KLEMIN
In charge, Daniel Guggenheim School of Aeronautics, New York University

D. H. KILLEFFER
Chemical Engineer

## Foundation Exploration With 36-inch Drills

A MOST valuable recent contribution to exploration work is the large-diameter core drill which drills smooth-walled holes large enough in diameter to permit the engineer or geologist to enter the hole and examine the exposed section of rock in place. Such is the introduction of *The Reclamation Era* to a discussion of the new Calyx shaft core drills made by the Ingersoll-Rand Company.

Drilling is accomplished by a rotating cylinder of the proper diameter employing shot as a cutting medium or, in soft rock, using steel or hard alloy cutting teeth. The core is broken loose from the bottom of the hole by small charges of explosive inserted at three or more points in the bottom of the circular cut, or by wedges driven between the core and the side wall of the hole. The latter method has proved more successful when the rock is soft and susceptible to shattering by the explosive. The core is then lifted by an eyebolt wedge device inserted in a small-diameter hole drilled in the center of the core, or by means of a cable sling around the core when the material is too soft to permit the use of an eyebolt. In soft, friable, or broken material which does not permit extraction of cores intact, sections of the cores are broken and the materials removed by a large auger with scarifying teeth. The finely broken material is lifted on the auger itself.



Drill core from a 36-inch hole

These large drill holes afford a means of inspection of rock in place which is superior to any method available. For instance, the side walls of shafts put down by the usual mining methods are generally shattered and disturbed by the explosive used and much of their area must necessarily be hidden by timbers. In drilled holes, a smoothly cut, in some cases, almost polished, continuous surface of undisturbed rock is available for examination. The spacing and tightness of joints, seams, and fissures can be observed, and the existence and nature of soft layers not ordinarily recoverable in small-diameter core drilling is disclosed in a manner not possible in the broken walls of test pits or shafts.

The Ingersoll-Rand Company furnishes machines for diameters up to six feet and for depths of 1000 feet or more.

## Polarizing Material

A LIQUID polarizing material, which is capable of being directly applied upon glass, has been discovered by Maurice Zahna and Harry A. Silverman. When dry the material adheres to the pores in the surface of the transparent body and expands or contracts, through changes of temperature, with the body. This obviates the possibility that the polarizing medium will become buckled or distorted by heat during use.

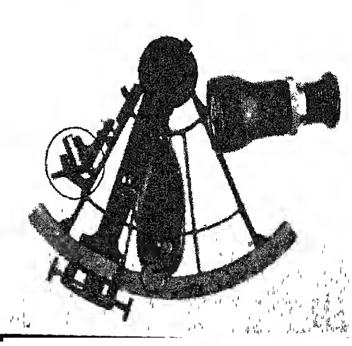
It has been demonstrated practically that polarized glass prepared with this material gives no distortion of light, which favors its use in microscopic, photographic, and scientific work. Because of the comparative simplicity of production the cost can be materially reduced.

A direct and important application of the discovery is in the field of color photography. It is now possible to produce colored polarized light filters as a single unit, and the employment of separate color and polarizing filters will no longer be necessary.

## Mirrors For Sextants

THE conventional mirror for sextants for marine navigation is made of glass, with both sides ground parallel and optically flat. The rear surface is silvered and given a coating of paint for weather protection. Mirrors of this sort are excellent as long as the silvering remains in good condition and the surface of the glass is not scratched or otherwise damaged. Moisture, however, soon penetrates the protective coating.

In its hydrographic surveying, the United States Coast and Geodetic Survey uses sextants not only for navigation but for measurement of horizontal angles. The instruments are subjected to frequent wetting from spray, with the result that the salt water soon destroys the silvering.

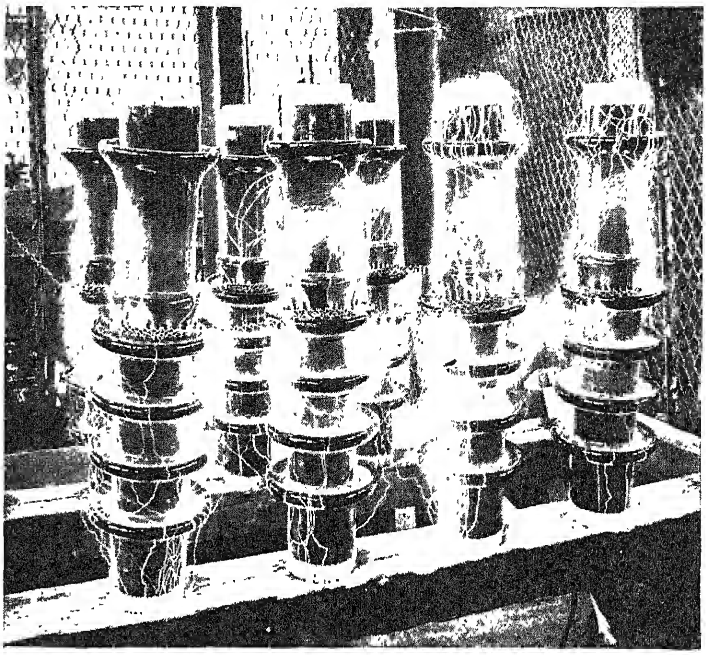


To remedy this trouble, experiments were conducted with mirrors made of the non-ferrous alloy known commercially as Stellite. This is an extremely hard metal which does not corrode easily, which takes a high polish and has good reflecting properties. Some apprehension was felt that a metal mirror might give trouble by warping and a careful check has been made upon this detail.

At first, some trouble was experienced with a cloudy appearance in the mirrors, due to large numbers of extremely small holes. The makers were able to remedy this defect and after some years of use, the Survey finds that these mirrors are almost universally as good as new. There is practically never any sign of corrosion or staining. The material is so hard that it does not scratch readily and can be easily wiped clean, when wet or dirty, without damage.

Careful check with a quartz optical flat has not divulged any case of warping, and the fact that these mirrors are front reflecting, not rear reflecting like the glass, means that there is no loss of light because of transmission through the glass or due to change of medium, nor is there any error due to lack of parallelism of front and rear faces.

While the initial cost of Stellite is somewhat greater than glass, the long life and freedom from expense of resilvering and from loss by breakage or scratching make it an economical mirror to use, where the absolute maximum of reflecting power is not required.—*D. L. Parkhurst.*



**A literal bath of electrical fire surrounds these porcelain bushings on test at the Derry, Pennsylvania, Works of the Westinghouse Electric and Manufacturing Company. Flash-over takes place at 200,000 volts, the test being made to insure efficient service of bushings and insulators in high-voltage transmission systems**

### CINNAMON

**CINNAMON trees once grew in what is now Texas, millions of years ago, when there were dinosaurs to browse on their leaves.**

## Saving in Dead Loads of Buildings

In building design, the reduction of useless dead loads is even more important and has more far-reaching effects than it does in fast railroad transportation. However, there is a parallel in both these modern trends. In railroading, it means a gain in speed or a reduction in power costs, or both. In building construction, there is far less tonnage to handle and fabricate, and the work is speeded up with a consequent saving in both labor and material.

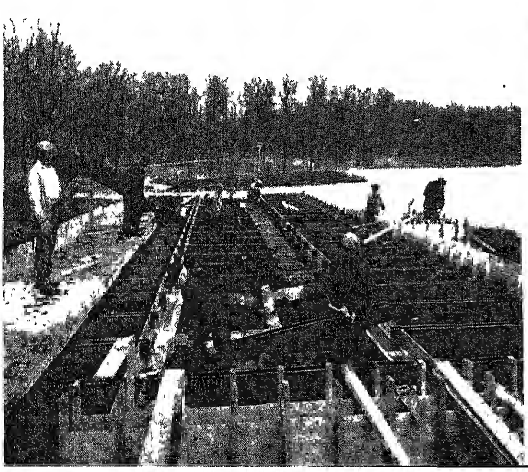
Startling claims are made for the latest improvement along these lines—a saving of 40 percent in construction costs. A new design of floor and roof deck construction has been perfected and patented by Eugene B. White, engineer and architect, which is known as the White-Steel Monolithic System. Dead loads are cut in half as compared with conventional concrete floors, it is claimed, and full strength is developed with only 20 to 25 pounds per square foot of roof deck and floor areas, including the weight of the beams.

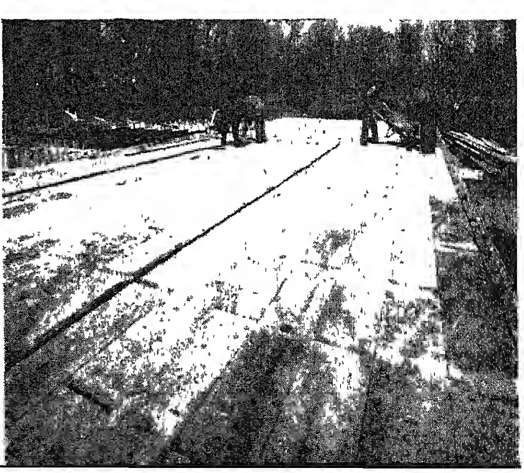
For both floors and roofs, the system is fireproof and steel purlins are eliminated in the latter. This, in itself, results in a marked lowering of construction costs. Lightening the dead loads carried, results in the reduction of the tonnage of structural steel required; also, in the size of the foundations.

As is well known to engineers and contractors, one of the largest cost items in connection with concrete floors and roofs is the form work. This is entirely eliminated in the White-Steel System. In place of it, hollow sections of light gage, cold formed steel are provided in which to cast the beams. These are full span length. While light and inexpensive, they are strong enough to provide an adequate working deck before the beams are poured.

On these hollow steel sections are placed pre-cast slabs of light-weight, reinforced concrete. The strong reinforcing mesh projecting from the ends of these slabs is turned down into the empty beam form from both sides, constituting a stirrup and making the reinforcement continuous through the beams and slabs. Then, the beams are cast with concrete poured on the job, a space being left between the slab ends for this purpose. Pouring is continued up to structural floor level.

For ordinary loads and spans, the beams are four and one half by six inches, spaced three feet center to center and reinforced with tension bars in the usual manner. A dowel-stirrup is placed through a hole in the center of each slab, projecting into the concrete beam beneath.





The use of these light-weight pre-cast slabs eliminates at least 70 percent of the concrete poured on the job and greatly speeds up the work. While the structural steel framing is being fabricated for the building, the light-weight concrete floor and roof slabs are being cast in a large, modern plant with special facilities for controlling the quality and strength of the concrete, such as steel forms, automatic water-control, vibration equipment for breaking and testing, et cetera. This pre-casting is of special advantage in cold weather which interferes but little with construction where the White-Steel System is used.

The system has been adopted as standard design on all new Y.M.C.A. construction throughout the United States.

**SHEEP**

**TEN thousand sheep were recently transported by plane across the Kara Kum desert in U.S.S.R. Expensive as air transport is, it is claimed that it is cheaper to take the sheep on the three-hour trip than it would be to drive them 325 miles across the desert, where food supply and protection constitute major problems.**

## Tracking Down Vibration

STUDY of vibrations in various types of equipment is an essential part of laboratory research and factory production. A device now available for conducting such study is so sensitive that it will pick up the vibrations from the escapement of a wrist watch, yet is rugged enough to withstand vibrations up to an amplitude of 1/16 of an inch. Briefly stated, this vibration pick-up uses a bimorph crystal mounted in an aluminum case and connected to a vacuum tube amplifier which operates either an oscilloscope or a loudspeaker. The prod, which is placed in contact with the machine or other equipment under test, causes the case to vibrate, whereupon the crystal flexes of its own inertia and sets up voltage impulses of exactly the same wave-form as the mechanical motion. This is reproduced either by the oscilloscope or by the loudspeaker.

A partial list of applications on which vibration study with this setup may be carried out includes: Production testing of electric motors, ball bearings, crankshafts, gear trains, fans, air-conditioning equipment, and locating sources of vibration in reciprocating or rotating machinery; checking relative smoothness of surfaces, such as paper, polished metal, gages, glass plate, and so on; checking longitudinal rods for fracture, and the relative efficiency of materials for deadening sound.

## Bottle-Fed Turkish Tobacco

CHEMICAL cultivation of Turkish tobacco in the laboratory, from a seed the size of a grain of sand to a giant flowering plant six feet tall, is reported by Professor Sam F. Trelease, head of the department of botany of Columbia University.

A tobacco plant that was bottle-fed

"Analysis of the soil of the Near East, natural habitat of the plant, revealed the exact proportions of a large variety of nutrient salts needed for the growth of the tobacco," Professor Trelease said. "Through tank culture in an earthen pot of pure silica sand we are able to duplicate the conditions of the soil by means of a carefully prepared chemical solution.

"The tobacco plant's dependence on the minor or 'tonic' elements is one of the most important of recent discoveries, and it may in a way be compared with the need of the human body for vitamins. Although but a very small quantity of either the chemicals in question or the vitamins is necessary, the need on the part of both plant and human being is actual and fundamental."

The tobacco plant, which requires four months to reach its full height of six feet, is fed one drop of chemical solution at a time through an elbow feeding tube connected to a Mason jar. The solution drips into the silica sand and is absorbed by the roots of the plant. The quantity of solution supplied varies from one to two quarts in 24 hours.

Using the same method of culture, but varying the ingredients of the plant food to suit the particular needs of each, Professor Trelease has also cultivated beans, green corn, and tomatoes. In addition, 16 different varieties of garden flowers, including larkspur, petunia, snapdragon, phlox, heliotrope, sweet pea, fuchsia, and nasturtium have thrived on chemical feeding in the Columbia laboratories.

**MOVIE**

**IN the first motion picture ever to depict the story of radium, platinum forceps and a special lead wall were used in order to protect actors, directors, and cameramen against dangerous emanations from the radium.**

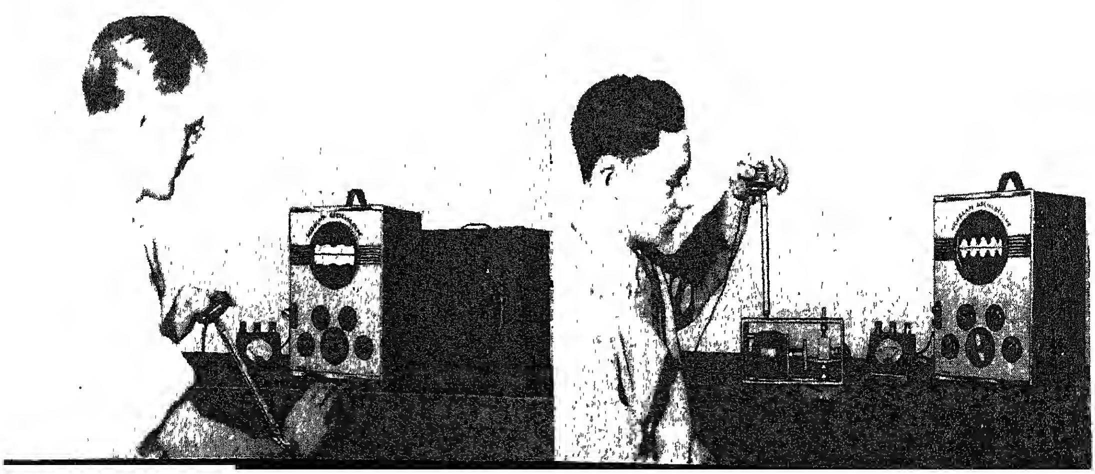
## Electrolytic Scale and Corrosion Prevention

BY placing an insulated anode in a boiler and making the boiler metal itself the cathode, pitting and formation of scale are prevented. The current consumption varies from 0.4 to 2 kilowatt hours per day per thousand square feet of boiler surface and the installation is extremely simple. The effect of the treatment is to prevent any significant corrosion or pitting and to keep scale-forming minerals in suspension so that they are easily flushed out. Direct current, of course, must be used.—*D. H. K.*

## X Rays for Sinus Disease

THE important part that X rays can play in diagnosing unsuspected sinus disease and in treating the condition in some cases is reported by Dr. Fred M. Hodges of Rich-

(*Please turn to page* 358)



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## THE SCIENTIFIC AMERICAN DIGEST

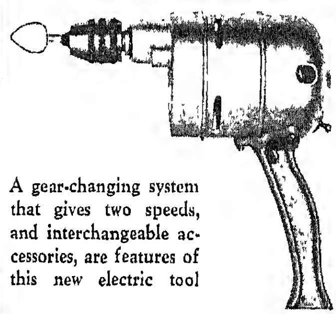
(*Continued from page 352*)

mond, Virginia. For 15 years it has been his practice to make a "scout sinus film" in every case sent in for chest examination, unless the condition found by X-ray pictures of the chest was sufficient to explain the symptoms.

"In this way," Dr. Hodges says, "a large number of unsuspected sinus infections has been found. Almost every common cold that failed to clear up after a reasonable time showed definite evidence of sinus infections."

### Two Speeds in New Electric Tool

SINGLE-SPEED utility electric tools are not new, but, by an ingenious gear arrangement—which combines two different speeds—a much wider range of usefulness is now available in a newly designed tool. The normal speed is ideal for heavy-duty



A gear-changing system that gives two speeds, and interchangeable accessories, are features of this new electric tool

work as in drilling, drum sanding, cutting, and so on; the high speed, four times the normal, is perfect for precision work as in carving, grinding, engraving, polishing, etching, and so forth.

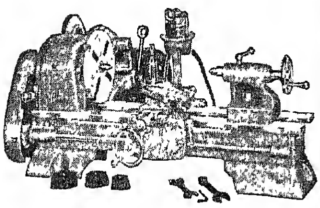
This new tool is fitted with a universal motor, operating on any 110-volt AC or DC circuit, with ball bearing thrust for smooth operation, a self enclosed cooling system, and a die cast alloy frame. The complete tool weighs 3½ pounds. Chuck is a 3-jaw coil-spring universal type and takes all sizes of shafts up to ¼ inch. There are over 200 accessories available, and they are instantly interchangeable.

### New Small Metal Lathe

LATEST development for the fast-growing army of metal working hobbyists is a new back-geared screw-cutting lathe with the construction features of an industrial machine tool scaled down for accurate machining of small work. It was designed for the shops of inventors, small-part engineers, modelmakers, jewelers, and home-crafters.

Early working tests class the new lathe as a sturdy machine tool. It swings diameters up to six inches and is available in two sizes, one accommodating 12 and the other 18 inches between working centers. On work within these dimensions it has the versatility which has made the modern lathe the basic machine tool. Handling such operations as turning, facing, threading, tapering,

a hearty welcome from not only the novice in metal working, but also from the advanced operators who tackle such projects as model engines, racing boats, airplanes, locomotives, and telescopes, cameras, radios, and so on.



Ideal for the small shop

Here are some of the construction details which make these new machine tools worthy of notice: reversible power feeds for carriage, complete V-belt drive, tapered roller spindle bearings, countershaft attached directly to the lathe, range of 16 speeds, and provision for maintaining permanent accuracy.

## Farm Battery or Power Radio Receiver

A NEW radio receiver especially designed for rural families living in areas where electric power is a possibility, but not yet an actuality, has been developed by the RCA Manufacturing Company. The Rura-Lectra radio, as it has been named, is a five-tube superheterodyne table model which will operate on either 110-volt AC power or a 6-volt storage battery.

The change-over from battery to power operation is automatic. The battery wires are disconnected and the power cord plugged into the electric socket for immediate operation. This new set will reach a large potential market in areas where the possibility of early or eventual electrification has made residents hesitant about buying ordinary battery operated radio sets.

Two tuning-band ranges of from 540 to 1720 kilocycles, and 5800 to 18,000 kilocycles, respectively, provide reception of domestic broadcasts and the short-wave and foreign entertainment on the 49, 31, 25, 19 and 16-meter bands, in addition to police and amateur calls.

## Kidney Infections Yield

THE new chemical germ fighter, sulfanilamide, which gives promise of conquering deadly streptococcus infections such as childbed fever, is apparently also winning the fight against infections of the kidneys and bladder.

Successful use of this chemical and its relative, Prontosil, in the treatment of these common and often refractory infections was reported by Dr. Russell D. Herrold of the University of Illinois College of Medicine at a recent meeting of the Society for Experimental Biology and Medicine.

"This drug would seem to be the first definite advance in the use of chemicals to combat infections since the discovery of the chemical treatment of syphilis," *Science Service* quotes Dr. Herrold. "It opens a new field in the fight against infectious diseases.

# TELESCOPTICS

## A Monthly Department for the Amateur Telescope Maker

Conducted by ALBERT G. INGALLS

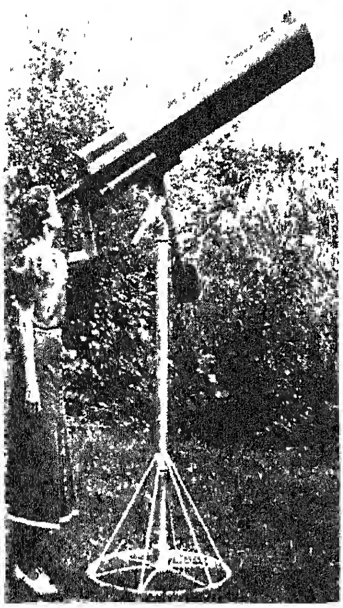


*Figure 1:* Mrs. Wells' Gregorian

WIVES who painfully watch their husbands making telescopes seldom seem to acquire the same bug themselves. However, Mrs. Dana W. (Nora L.) Wells, 16 Van Campen St., Dansville, N. Y., tells another story:

"I became interested in making a telescope through watching my husband make his 9" Newtonian. In the beginning I had no thought of making a compound telescope, but gained my first practical experience by grinding and polishing a 6" mirror made up of layers of wind-shield plate, which, true to what has been said of its type, proved in the final polishing not to hold its figure.

"My husband supplied the tube and mounting, the latter being of pipe-fittings welded to a fly-wheel as a base. The eighteen-sided wooden tube is made of lattice strips.

"My primary mirror is 8" in diameter and is pierced for the Cassegrainian and Gregorian set-up. The Newtonian focus is slightly over $f/4\frac{1}{2}$. The Gregorian secondary is approximately 10" from the Newtonian focus. I ground, polished, and figured both mirrors, also ground and polished a pair of plano-convex lenses for a Ramsden ocular of approximately 2" *e.f.l.* The finder was made of reading glasses of the pocket variety.

"As it could be figured directly without the primary, I completed the Gregorian secondary first.

"My Gregorian is somewhat difficult to keep on a star, but I have spent many enjoyable evenings with it. I get sharp, beautiful detail on the moon; and Saturn's rings, Jupiter's zones, belts and satellites, as shown by the telescope, are of never-ending fascination to me. The making of my telescope maker's usual troubles. What I do not know about optics would fill many a book, but that I have, by the liberal use of 'Amateur Telescope Making,' been able to fashion a workable instrument, gives me considerable satisfaction."

CEMENTED skeleton glass disks may or may not hold their figure. Often, when they do, it is difficult to ascertain whether the front disk held its shape without actual aid—the other parts then being mere excess baggage—or whether an actual structural unit has been created: In ATM, p. 308, there is a note bearing on cemented disks. Thomas A. Martin, resident at 126 Monroe Ave., in the famous Wisconsin center of gravity of the overall industry (see Figure 2) says:

"I am sending you a picture of my latest telescope. Total cost, $15. The mirror is made of two 12-inch disks, five-eighths of an inch thick, cemented together with 12 glass blocks between. It took 16 hours to complete the mirror with what I think is a pretty fair parabola.

"The mounting is constructed entirely of used two-by-sixes—very inexpensive but remarkably stable. The whole thing rolls out of the garage on four bed casters. The tube is made of 22-gage iron. The top 18 inches, holding the eyepiece, can be turned to the most comfortable position."

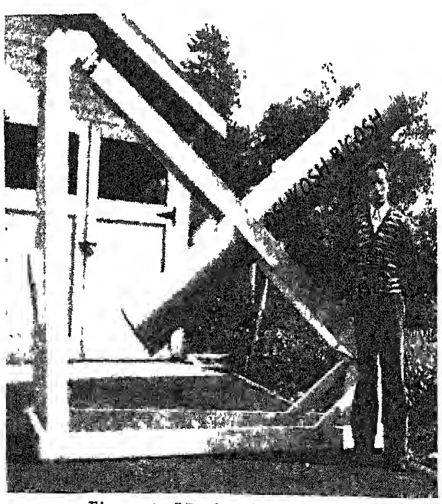


*Figure 2:* Martin of Overall City

Having gone so far as to equip his telescope with bed casters, the maker may have missed a trick in omitting the bed itself—especially as the bed of the mounting has just about the right proportions to receive one. Seriously, R. W. Porter, years ago when working out the indoor telescope shown in ATM, at *V* on p. 51, tried to arrange it so that he could use it from bed. This would be the very *summum bonum* in telescopes and the problem is passed on to others who may care to lie abed and expend gray matter on it.

WHATEVER a man designs and makes spect it. Some amateurs' telescopes are roughly designed and inefficient, others roughly designed but efficient; still others are smooth in appearance but mechanically lacking at some vital point or points, while a few are both well designed and easy to look at. The one shown in Figure 3 was noted at the *Stellafane* convention, where it was brought last summer, because it seemed to fall in this fourth category, and the following data were given by its maker, Philetus Allen, 45 Sheridan St., Glens Falls, N. Y. It is a 6" and has heavy axes, the PA being 1 15/16" and the Dec. axis 1 11/16" in diameter. The heavy base casting weighs 105 pounds and is of solid bronze—a beautiful metal. Allen made his own pattern. The main ring around the tube's waist is 6" wide, ⅝" thick and is of solid bronze, as are the two end rings. The tube is finished in antique bronze. The whole job has a sleek, clean appearance—good taste, both mechanical and aesthetic.

Figure 4 shows the adjustable eyepiece rack which carries with it the prism mounting—an old idea but an efficient one, cleanly worked out.

SMOOTH also is the 7" Cassegrain shown in Figure 5, the optics by A. Priselac, the machining by Emil Kelly, members of the Amateur Telescope Makers of Pittsburgh. "This one really works as nicely as most refractors," we are told by Leo J. Scanlon—"splendid definition, smooth mounting, professional touches."

AMONG amateur telescopticians (isn't that at least as good a word as mortician?) there is a group having an interest in clock drives, and a more or less refined mathematical interest in gear trains that will split fine hairs in accuracy of time keeping. E. C. Stanton, Washington, D. C., writes:

"How's this for a polar axis telescope

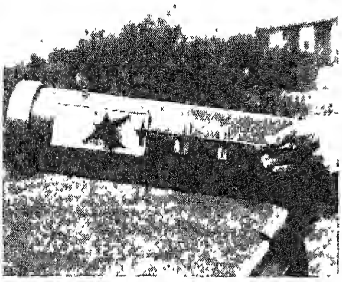


*Figure 4:* Allen's sliding unit

drive? Starting with 1 revolution per minute, given by any clock motor, the drive shaft connects with a gear of 44 teeth, meshing with another with 179 teeth on a worm shaft; the worm wheel is on the polar axis and has 353 teeth. This mechanism will rotate the axis in 1436 3/44 minutes, equal to 23 hrs., 56 min., 4.091 sec., which is the length of a sidereal day to the last decimal place given in the Ephemeris. In a tropical

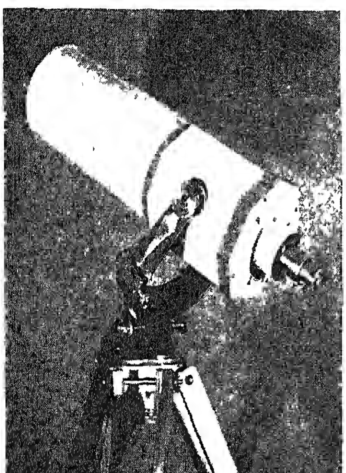


*Figure 5:* Made in Pittsburgh

year of 365.24219879 days the axis would be revolved 366.24219721 times, an error which amounts to 1 degree in 1760 years.

"This is offered to your fans with my compliments—and a challenge to beat it in accuracy."

Of course, at this point or sooner, the question becomes mainly one of the pursuit of the ultimate for its own sake rather than a practical one, but even this is of much interest to those who enjoy refinements of method. Hence we reprint a part of a letter which appeared a year ago (Nov. 28, 1936, p. 931) in *Nature* (London). Its writer is the same F. Hope-Jones who is prominently mentioned in ATMA in connection with the Synchronome clock (pp. 427-446), and it looks as though the Dr. Comrie mentioned in it, a mathematical astronomer at the Greenwich Observatory, had beaten the challenge mentioned above, even before it was issued.

"The problem involves the precise expression of the ratio between the sidereal and mean time in the form of a train of gear wheels. Since one mean solar day is $24^{h}\ 03^{m}\ 56{\cdot}555\ 36^{s}$ in sidereal time, the ratio of sidereal to mean is $1{\cdot}002\,737\,909\,3\ldots$. This ratio must be expressed by a fraction; for our purpose the numerator and denominator of this fraction must both be factorizable

reasonably exceed this. Moreover, the number of factors (or suitable combinations of them) in the numerator and denominator must be the same, as wheels must work in pairs.

"The first to accomplish it was George Margetts, a member of the Clockmakers' Company *circa* 1800. It is in the form of a large watch and is to be seen in the Company's collection in the Guildhall. It has separate dials for hours, minutes, and seconds, each having a smaller dial mounted concentrically with the larger ones. These inner dials were gradually revolved backwards by gearing, so that the same three hands indicated simultaneously mean time on the outer dial and sidereal time on the inner dial. His train includes a wheel of 487 teeth so fine that they are invisible to the naked eye. The ratio is $\frac{1465}{1461} = \frac{5 \times 293}{3 \times 487} = 1{\cdot}002\ 737\ 85$, which is correct to the sixth decimal. The sidereal component would lose at the rate of $1{\cdot}8^s$ in a year.

"In the Science Museum there is a clock designed by Joseph Vines a hundred years ago (1836), with two dials coupled by the ratio $\frac{43 \times 247}{32 \times 331}$. This is 1·002 737 915 4, which is correct to the seventh decimal. It will take 5·2 years for the sidereal dial to be in error relatively to the solar dial by one second.

"Paris adopted a train by Ungerer, of Strasbourg, $\frac{119 \times 317}{114 \times 330}$, which is 1·002 737 905 4, and correct to the eighth decimal; it will be 8·2 years before it is a second wrong.

"Sir George Airy contributed to the *Monthly Notices of the Royal Astronomical Society* in 1850 a train by Dr. Henderson, $\frac{50 \times 182 \times 196}{30 \times 211 \times 281}$, a ratio of 1·002 737 908 5. This is very close, being correct to the ninth decimal, and requiring 40 years to accumulate an error of one second.

"At this stage of the investigation, I was fortunate in interesting Dr. L. J. Comrie who, as a result of 'a pleasant week-end's arithmetical recreation,' summed up the whole matter and contributed a solution which we may accept as final. He gives the true ratio as 1·002 737 909 265, plus the centennial term, and a wheel train of $\frac{45 \times 71 \times 257}{29 \times 151 \times 187}$ which is the value of the precise ratio required in the year 1955, namely, 1·002 737 909 297. The error would amount to one second in about 100,000 years."

At this point hard-headed extraverts who may consider all this sub-splitting of ultra-microscopic hairs a trifle over-refined for us mere amateurs with plain back-yard telescopes which may or may not even sport an alarm clock drive are entitled, if they wish, to offer the yarn about the Yankee salesman who was working hard on a western farmer trying to sell him a cornsheller. At great length he urged its purchase but the farmer, throughout the sales talk, wore a puzzled expression; and finally, when the torrent weakened a bit, he managed to say: "Yeah, but what's the purpose of it?" Came the reply: "Why, man, think of all the *time* it will save your hogs in eating." His eyes at last brightening up with a sudden inswered: "Haw haw! What's time to a hog?"

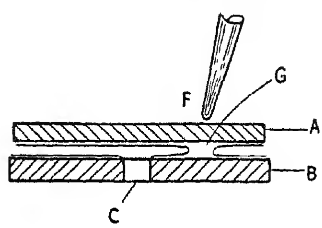
Nevertheless that outstanding one second in 100,000 years is a challenge to all mathematically-minded introverts. It's scandalous!

When the above letter was first published in *Nature* the *London Times* stated that "A new clock whose error is only one second in about 100,000 years is described in *Nature* by Mr. Hope-Jones." The Astronomer Royal soon pointed out that one second a year was the clock record, and that there was no actual clock of that refinement; the calculations merely tell what could be—if other sources of inaccuracy did not far outrank this one.

ONE function of this telescoptical columnist (or telescoptimist) is to keep a weather eye on scientific journals of limited circulation, and reproduce here items from them that may interest other amateur telescopticians. Hence another letter from *Nature* (Aug. 21, 1937), by Dr. James Weir French, of Barr and Stroud, Ltd., optical manufacturers, Glasgow, Scotland:

"It is not generally known that by a simple device so-called optical contact can propagate itself.

"Contact is usually produced by the application of considerable pressure, first on the center of the plate and thereafter in a spiral path outwardly to the periphery. If, however, the test plate is pierced by a small hole and pressure is applied at one point and



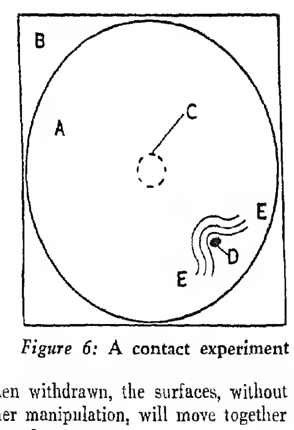




*Figure 6:* A contact experiment

then withdrawn, the surfaces, without further manipulation, will move together into optical contact.

"In Figure 6, *A* is an optically polished glass disk, lying upon a test plate *B*, pierced by a hole *C*. Pressure is applied, say, at *F*, and then withdrawn. The Newton rings around the point, without further assistance, expand and disappear, leaving the surfaces in pseudo-contact and in darkness devoid of colors. A small speck of dust, such as *D*, will not arrest the movement. It is interesting to observe the rings at *E* attempting to encircle the speck and ultimately doing so, leaving around it two small bluish white rings, separated by a mottled dark one. These white rings suggest the following explanation of the phenomenon under consid-

"Optically polished glass surfaces, unless they are specially treated, have surface layers of something akin to grease. Pressure at $F$ bends the plate $A$ sufficiently to join the grease films, as at $G$. Surface tension forces around $G$ expel the air and extend the liquid continuity over the whole surface. Light falling upon the area $G$ passes through more or less completely, according to the equality of the refractive indices of the grease and

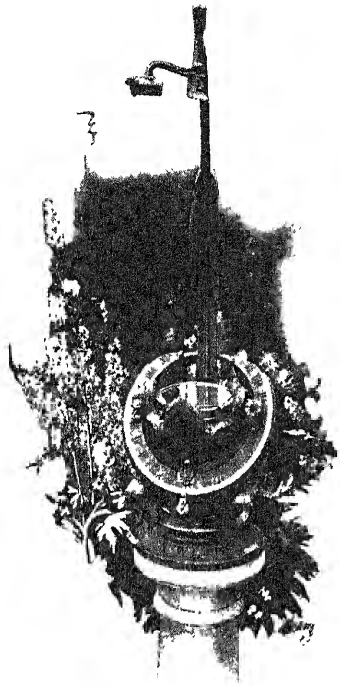


*Figure 7:* The Garden Telescope

glass. Viewed from above, the liquid region $G$ appears dark and, from below, bright.

"Light is reflected from the rounded surface tension contours, which regions appear bluish white. Newton rings may appear in the remainder of the area. From measurements made by Sir Isaac Newton, I reckon the thickness of each grease layer to be less than one millionth of an inch."

HOW many of the more recent amateurs have ever heard about the Porter Garden Telescope? Figure 7 shows one of these handsome decorative bronze mountings. About 1923, when R. W. Porter was optical associate of the Jones and Lamson Machine Company, in Vermont, and before this magazine had adopted the infant amateur telescope making hobby, he designed, made, and his company sold, 75 or 100 of them. They had 6" mirrors and were $f/4$, and sold for 400 dollars. Many of the mirrors were figured by a local lad named Wilbur Perry, whom Porter trained to do this work, and he took to it like a duck to water. Later, Perry took a position making diffraction gratings with Prof. R. W. Wood of Johns Hopkins, and is doing that ultra-skilled work today. For the Garden Telescope Porter employed his split ring equatorial principle which has been adopted for the 200" mounting. None of these telescopes are to be had today, in case any reader suspects this of being a subtle advertisement. The irregular swelling of the spinal column is a representation of a leaf, and another leaf swings

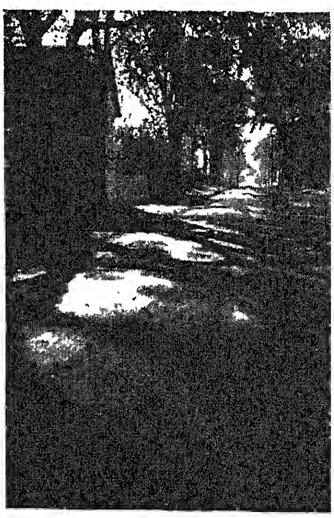
# CAMERA ANGLES

Conducted by JACOB DESCHIN

## Pictures on the Highway

SOONER or later, you were bound to learn this department had acquired an automobile. So, get ready; you're in for it right now. All that the car needs is a built-in darkroom and our joy would be complete. Of course, you know that two or three heralded trailers (doubtless some unheralded ones, too) are thus equipped—photographic gypsies, they might be called. And that, to us, is just about the peak of photographic bliss—taking and making pictures on the road.

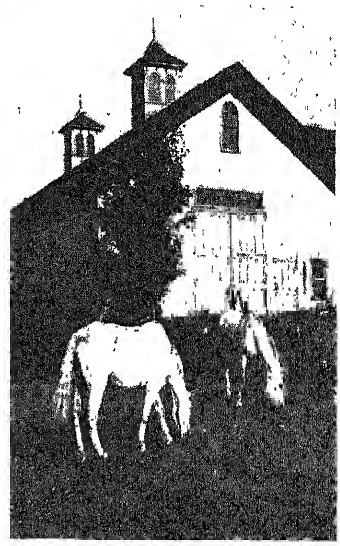
Here's the way we squared it with our conscience and the lady who wears the trousers. For a city feller like us, cooped up in New York, with a job and duties, a car seemed the only way of getting out at least over week-ends to the open spaces



"The Road Ahead"

where picture material abounds that is seldom obtainable within the limits of a great city. City pictures are often very fine things, but at least once in a while a fellow should hie himself out to the country and shoot some pictures where the green grass grows and nobody is ever in a hurry.

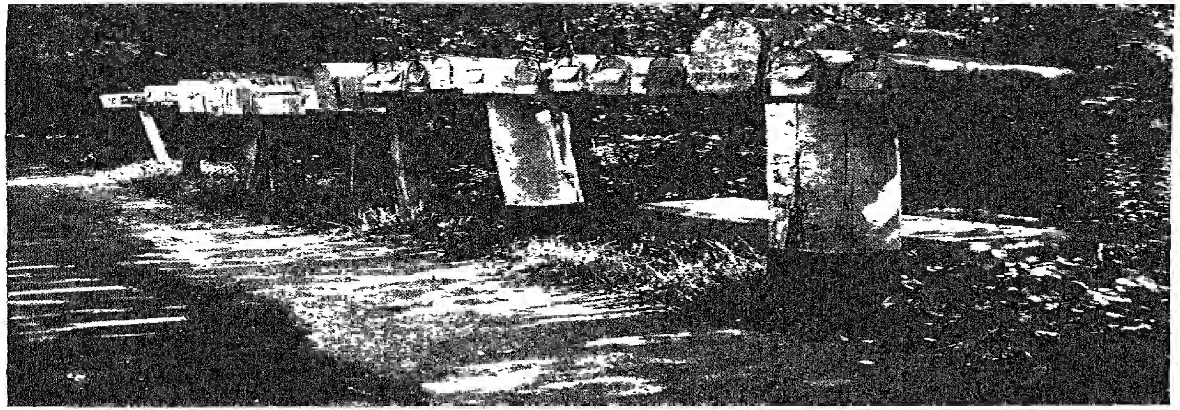
You could go out via bike or take a picture train, or maybe a bus, but if you used a bike it would take a good part of the day just to get out of the city, not to speak of trying to get back again in the crush of cars returning to the city on Sunday night. You would do better with a bus, but you have to have a destination, and that's always bad because the adventuring picture-taker doesn't always know where he's going, if



"Rustic Peace"

to whatever destination he may loosely have decided upon, that's all right too. It's the picture that counts.

The Sunday picture train is a recent innovation which goes a long way toward making up to the city chap for the things he misses because the circumstances of life, or perhaps even his own inclination, keep him all week in the city. We have a note farther on in this department about the picture train. This is probably the best thing yet; but now that we have experienced the joys of picture-taking via car (someone has even given it a name, "motographing"), we must say, for our part, that, be it ever so humble, there's nothing like it.



"All in a Row"

The illustrations constitute part of our first harvest. The letter boxes are a common sight, but it's not always that one meets with a row of them lined up and lighted in the way we found them one Sunday morning, and not the least of the picture's attractiveness was the variety of box sizes, shapes, and their supports. "The Road Ahead" puts over the feeling of the leisurely motorist who has escaped to the byways. "Rustic Peace" is another fairly common sight along the road, and if you don't find horses, there are sure to be cows. Of course, they are not always as close as this particular subject, but climbing a fence should not be a misdemeanor if your mission is as peaceful as that of photography. The slightly aslant chap leaning against the truck saw us hunting about with a camera and bluntly asked to have his picture taken and here you have it.

More anon about our "motographing" expeditions.

## For Makina Owners

SEVERAL changes have recently been made in the complete Makina outfit. A special, separate leather case is now included to hold the Tele-Makinar F:4.8 and the Wide Angle Orthar F:6.3, together with view finder masks. This is supplied with a shoulder strap and may therefore be carried independently of the complete Makina case when desired. Also included is a specially designed lens shade and the special tripod head for properly balancing the Makina when using a tripod. The lens case, lens shade, and tripod head may also be obtained separately.

## Greeting Card Time

THIS is the time of year when greeting cards assume *major importance* in the life of the amateur photographer. Since the work involves more than ordinary pains, some are content to turn out a fair-to-middling job and let it go at that. As in everything, badly. To do it well doesn't require much more effort than to produce the makeshift, so why not take the extra trouble and do it right? The results will more than pay for themselves in the satisfaction you will get from turning out greeting cards that are at least to some degree original and beautiful.

Look through your negative file and see what it offers in the way of suggestions. Perhaps toning will help, or lettering on the print, or a combination of two negatives. A snow picture taken last winter makes a swell subject, and a happy baby's smile is always a winner. Or you may find it more satisfactory to make some new negatives. Try a table-top with some materials selected at the five-and-ten. Whatever you decide to do, make it good. Everybody will appreciate it, yourself included.

## Servicing Electric Exposure Meters

THE growing use of electric exposure meters among the great mass of camera owners has introduced the problem among the principal distributors of electric meters of how to educate the photographic public in the proper care and handling of these instruments. The extreme responsiveness of the meters to every change in intensity of light reflection indicates a delicate construction which, indeed, compares with that of the workings of a watch. The fine hair springs by which the exposure indicator is controlled will not stand undue jars and general carelessness in use.

When something does go wrong, it is imperative that the user should not attempt to make any repairs himself, any more than he would attempt to repair a watch. Experienced hands used to the task of adjusting or repairing the particular meter in question are the only ones that should repair the invalid meter. The layman who attempts repairs himself is very likely to cause more damage.

ments, manned by experts, are maintained by the two leading distributors of electric exposure meters in the United States—the Weston Electrical Instrument Corporation, Newark, New Jersey, distributors of the Weston Exposure Meters, and Photo Utilities, Inc., 10 West 33rd Street, New York City, importers and distributors of the Mini Photoscop. Both invite photographers to send in any meters that need attention, but require that the owner state frankly just what has happened to the meter (where the user is able to give this information), and to say whether the meter has been dropped or has been tampered with in any way.

Frequently these organizations are approached by owners of foreign meters which have no regular representation in this country and are therefore difficult to service because replacement parts in many cases are not available. Depending on the circumstances and the extent of the required repairs, these companies are sometimes able and willing to help. They do not, of course, assume any responsibilities in the case of any meters except those distributed by them.

## Leica Show Rules

ANNOUNCEMENT is made of the rules governing the submission of prints to the forthcoming Fourth International Leica Exhibit, made public by this department in a previous issue. No entrance fee is required and no limit placed on the number of prints that may be submitted by any one prospective exhibitor. The rules follow:

1. The name and address of the photographer, plus the following data (if possible), should be included on the back of each print or mount:
   a. Lens and aperture used
   b. Exposure
   c. Film used
   d. Developer for above
   e. Filter, if any
   f. Other accessories used in making the picture.
2. Prints may be sent mounted or unmounted, conforming to the following sizes: 8 by 10 inch prints on 13½ by 17 inch mounts; 11 by 14 inch prints on 16 by 20 inch mounts; 16 by 20 inch prints on 22 by 28 inch mounts.
3. Contact prints should accompany entries but should not be pasted on mounts.
4. The closing date for the receipt of prints is Nov. 30, 1937.
5. Packages containing prints should be sent to E. Leitz, Inc, 730 Fifth Avenue, New York, N. Y., and should be marked "Exhibit" in the lower left corner.

## Many Buyers But Few to Sell

TIME was when one could buy any camera or photographic gadget on the market provided one had the cash to pay for it. At worst, there was only a short delay. Today we are living through the paradox of many willing to buy and pay but few available cameras and accessories to sell. It isn't any one camera or two or three, nor does this condition apply only in the case of imported cameras. Even camera manufacturers in this country are unable to keep production to the pace of the buying demand.

There are those who see in this phenom-

tificial condition which must soon wear itself out and cause a reaction. It is not our province to act the seer nor would we care to argue the point. We do hold, however, that no enthusiasm is unhealthy and if photography some day falls away in general favor, what does that matter? It will come back again, and again. Let it not be forgotten that photography was not born yesterday. It is 100 years old, and still going strong, stronger today, in fact, than ever before. In any event, the real enthusiasts will remain—the others don't count.

### In the Park

Take your camera with you every time you visit the parks. You probably do it anyway, but some of us are often discouraged because sometimes it seems there isn't

"Master and Pupil"

"a thing to take." That's where you're wrong. There's plenty to take. Trees are beautiful, and so are certain aspects of the water, of flowers and bends in the road. And if all these fail to attract you because the lighting is bad or whatever, how about "shooting people in the back" engaged in some such pose as that shown in "Master and Pupil"?

### Pergrano 35 mm Film

Rated at 17 degrees Scheiner and declared to be almost 100 percent grainless, a new 35-mm film emulsion is now available under the name Pergrano, the latest addition to the line of Perutz films, which includes, besides the new film emulsion, the following: Perpenso, Perpantic, and Peromnia. Pergrano is described as having "a fully balanced panchromatic emulsion of beautiful gradation" that "will do justice to the finest lens made" and "may be developed, fixed, and dried quickly." The new film is available in daylight loading spools for 35 mm, vest pocket, and 6 by 6 cm cameras.

### Photography Marches On

The tremendous interest in photography that is apparent on every hand today was recently the theme of a radio interview by Karl A. Barleben, Jr., F.R.P.S., direc-

with Joseph Dombroff, president of the Photographic Dealers Association and vice-president of Willoughby's. Mr. Dombroff, speaking from an experience of 27 years in the business of supplying photographic amateurs and professionals with equipment and materials, gave an inkling of what is going on today from the viewpoint of the man behind the scenes.

"In 1910," he said, "the camera fan was a bit different from what he is today. I remember the time when to possess a camera was *something* . . . whereas now, it's nothing for a real enthusiast to possess three or four. And you should see the exchanging that goes on, too. Fellows swap their cameras with one another all the time these days."

Photography, he continued, is growing "by leaps and bounds, because nowadays photography is a hobby in which everyone can indulge himself—rich or poor, young or old. Anyone can make a good picture, and the technique can be easily acquired in no time. I think photography has so much to offer—it gives pleasure to the fellow who takes the pictures, and just as much to those whose pictures have been taken. And its use has spread over practically every phase of life—industry, art, advertising, news, science, exploration, even war. It is the best means of perpetuating memories of the past, and unlike brush and paint, or type and ink, requiring the expert user, it is possible to enjoy photography and the taking of good pictures, no matter how much of a novice one may be."

Photographic magazine "consumption" by amateurs has increased greatly, Mr. Dombroff disclosed.

"Twenty years ago our organization sold about a dozen copies of the leading magazines a month. Today we sell well over 3000 copies a month. And that's plenty of progress. I've found, too, that the individual is not content to read just one of the magazines—he'll buy and read at least four or five different ones each month. This, to me, shows that our modern picture snappers are seriously interested in adding to their photographic knowledge, and also accounts for the higher grade of photography seen on every hand."

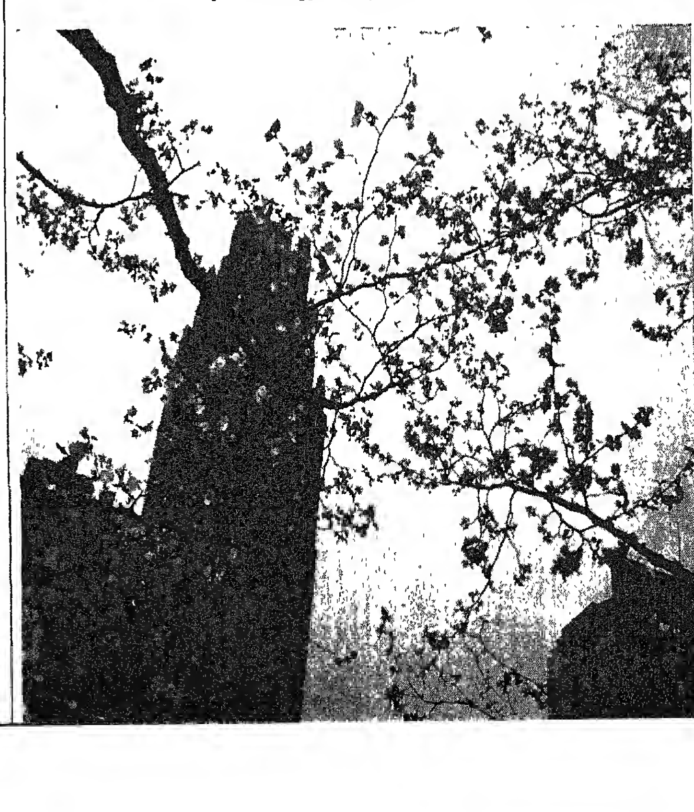
Mr. Dombroff also mentioned the interesting fact that the King of Siam, or, rather, the former King, whom he met in a business way during one of his visits to America, owns more cameras than any other single individual in the world—more than 300 of them!—"And he takes many of them with him on all his trips."

## Square Negative Hint

WHOSE side are you on? The fellows who say they find the square format disturbing when they try to compose for the ultimate rectangular print, or on the side of the square negative champions, who say there is nothing like it because they don't have to alter the position of the camera when taking vertical pictures? On one side or the other, here's something for users of square-format reflex-type cameras to think about. Cut a piece of metal, cardboard, or other suitable material about ½ inch wide and about 2¼ inches long. Drop it onto one side of the ground glass and there you have your rectangular image. If you cover the ground glass at the right you will have a vertical picture; for the horizontal, the upper edge of the ground glass should be covered with this mask. The mask may be supplied with a glued handle of some sort to facilitate its removal and insertion.

## Contrast

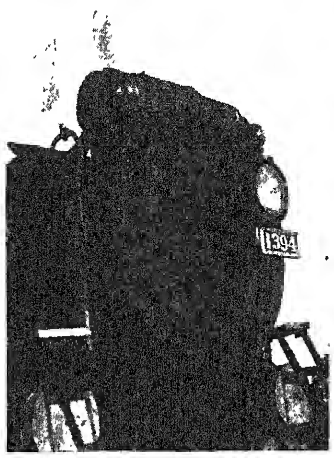
WE mentioned the attractions of contrast in picture material in this department once before, but the subject is so intriguing we cannot resist reverting to it again this month, especially since we need some excuse to print the illustration, "Lyric Touch." The tower in the background and the commercial clock and sign in the lower right-hand corner unmistakably give the flavor of business, while the tree branches in the foreground, leafy with the first signs of spring,



provide that atmosphere of nostalgia and "spring fever" that is as strongly familiar at the noon hour to the high-powered executive as to the humblest office boy. The upward tilt of the camera slanted the building to give body and some essence of solidity to the background.

### THE PICTURE TRAIN

EVEN the railroads are recognizing the fact that photography is all the rage these days. So they have instituted the "Picture Train" idea, and it is evidently a huge success. You leave about 8 o'clock in



"Picture Train"

the morning and come back at night. The train takes you to places which promise good picture shooting and returns you home with your pockets bulging with work for the darkroom. We are told that the first two trips attracted about 250 camera fans each, while the third time this number was almost tripled.

### ROBOT TABLE-TOP TRIPOD

A MINIATURE tripod, specially designed to accommodate the Robot camera in table-top work, has the appearance, when closed, of a "stick" eight inches long by about 5/8ths of an inch in diameter, provided with a carrying strap.

The distributors further describe the tripod as follows:

"One end of the stick carries a screw thread which fits in the underside of the camera, so that the stick itself can be used as a handle for the camera when this is used in the hand. By unscrewing the other end, an inner chamber is revealed containing 3 chromium plated rods, each 6 inches in length, which screw into a head and form a tripod.

"Sold separately is a ball and socket head which screws on to the table part of the tripod and permits the camera to be moved and set at any angle. The height of this table tripod with the ball and socket joint in place is 13¾ inches. For low work or in conditions where the full height is not required, the stick can be screwed off and the camera attached immediately above the tripod legs. The whole device is very well made and finished, and while it is primarily

## THE SCIENTIFIC AMERICAN DIGEST

*(Continued from page 359)*

a time as three days. Its action apparently is somewhat different from that of another useful urinary tract antiseptic, mandelic acid, which has become quite generally used in the past six months. It is destined to replace the acid almost completely.

"The new compound is much more palatable to the patient," Dr. Herrold said. "In one-tenth of cases, mandelic acid cannot be used. The new chemical has revealed no such limitations yet."

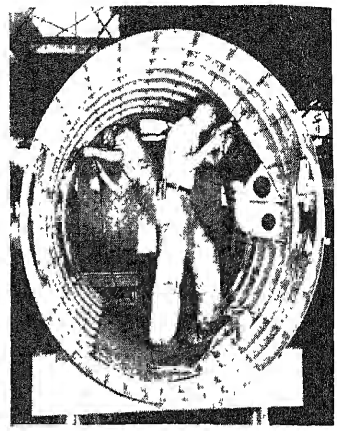
The chemical is taken by mouth in tablet form and, in serious cases, is made into a solution for hypodermic injection.

### Cashew By-Products

IN India, where the comma-shaped cashew nuts, so popular in the United States, are grown, efforts are being made to utilize the fruit producing the nuts for other purposes. Actually the nut grows outside a fruit very much resembling an apple. The demand for the nuts has left large quantities of these "apples" as waste. Lately the juice of this fruit is being concentrated, decolorized, and deodorized to yield a syrup industrially. Although this operation has been carried on in the past as a home industry, large-scale manufacture is being undertaken to produce a syrup for use in preserving ginger and mangoes. The shells which surround the nut itself are being utilized to yield germicidal soaps.—*D. H. K.*

### How a Giant Clipper is Built

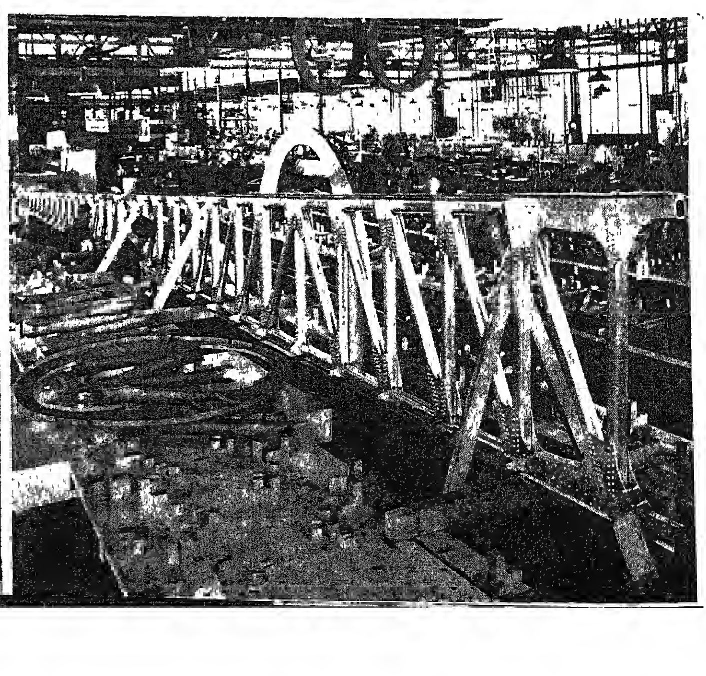
THE construction of a huge flying boat resembles far more the construction of an ocean liner than, for example, the production of an automobile. Such construction calls for strength in combination with the utmost refinement of design, and for a very high degree of skill among the workers. There is not the slightest doubt that airplane mechanics are virtually a race apart

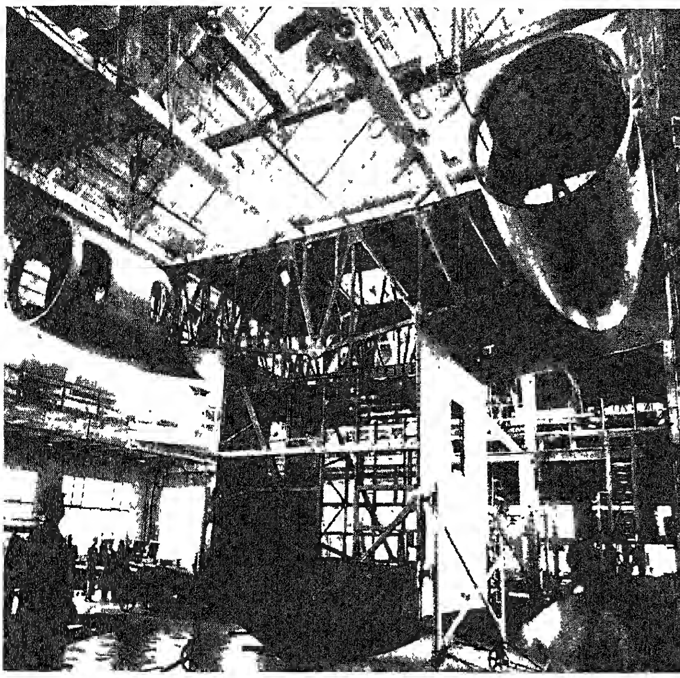


Riveting up the aluminum frames of one of the huge engine nacelles

in their intense interest in their work and their absorption in the problems of aviation. Yet their work is far from easy, and entails typical factory noises and other discomforts. In the old days, the construction of an airplane involved a few sketchy drawings, followed by rough-and-ready methods in the shop, with wood as the predominating material and many hasty changes as the work progressed. To-day, aluminum alloys and high-strength steel alloys have replaced wood; when construction is ready to start every part of the ship has been calculated, tested, and designed in detail by engineers and draftsmen before a single part is fashioned in the shop. Our photographs give an excellent idea of the assembly and construction methods in the largest American flying boat yet to be built, the Boeing *Pacific Clipper* which will carry 72 passengers. The wing span of the new boat will be 152 feet, and it will be powered with four 1500-horse-power Wright Cyclone motors.

Naturally, when the width of the span reaches 152 feet, the loads on the wing and hence on the wing beams become very heavy. No wonder, then, that the truss-type wing beam is almost as high as a man at its inner end and has the solidity of appearance of a bridge girder. The wing is first assembled on a special jig and then riveted up, with thousands of rivets to be inserted and headed over by the mechanics.





Center section wing beams of the *Pacific Clipper,* attached to the hull

The center section wing beams are rigidly attached to a portion of the huge hull. That portion of the hull illustrated contains the dining salon on its lower deck. Space above the center section of the wing structure will be used for cargo. On the outer ends of the center section of the wing are shown the two inner engine nacelles, which stand 25 feet above the assembly floor. All four engine nacelles will be accessible during flight by means of wing companionways.

Nothing gives a better idea of the size of the engine nacelles than the picture of the men standing practically erect inside them, busily at work riveting up the aluminum frames.

Every process known to modern machine science is pressed into service in this construction work—drop-forging, rolling, pneumatic riveting, stamping, and so on.—*A. K.*

## Kites to Carry Radio Antenna

THE kite is perhaps the very earliest form of flying machine. Invented by the Chinese, it has been regarded for centuries as a fascinating toy for boys. But Benjamin Franklin used the kite for electrical investigations; the Wright brothers used it for obtaining aerodynamic data. Now Hugo Leuderitz, Chief of Communications for Pan American Airways, has put the kite to another practical use, by making it carry a radio antenna after an emergency landing at sea. The trailing wire antenna is, of course, useless when once the aircraft is on the water, and the antenna stretched between wing and tail surfaces is not high enough in the air to be really serviceable.

After practical research, Mr. Leuderitz has developed a practical six-foot kite with a red cloth cover. The kite will lift in a moderate wind, will fly from the back of a *Clipper*, and will function when soaked with water. The kite is packed in a six-foot aluminum mailing tube, with a simple reel of strong line; the whole device can be screwing up a wing nut, and inserting a few safety pins. Red cloth is used so that the kite may serve as a flag as well as an antenna carrier.

While no emergencies have yet occurred to test the system, all the experimentation to date indicates that Mr. Leuderitz has developed a useful safety device.—*A. K.*

## Improved Trainers for Blind Flying

WE have had occasion to describe the Link trainer in its early stages, when it was considered simply an introduction to the handling of the flying controls. It was mounted so that it could rotate through 360 degrees, pitch, roll, and simulate all the attitudes of actual flight. Then the Link trainer received a hooded cockpit and a full complement of instruments, and became useful in preparing men for blind or instrument flying. In its most modern version the trainer has radio facilities, and is used for teaching the difficult art of flying by radio. United Air Lines is making wide use of the device in its latest form.

A highly experienced instructor sits at a special control table of the trainer and simulates radio range signals, marker beacon signals, two-way radio communication, flying attitudes, and varying wind conditions. On the airway chart in front of him there is a movable instrument which constantly records the artificial flight path that the student in the Link cockpit has achieved on the basis of the signals given to him by the instructor. The instructor adjusts the control panel to duplicate the radio pattern of a particular part of the airway network, and then requests the pilot in the cockpit to orient his position and "fly" the plane to a given destination. The pilot must compensate for simulated wind and weather conditions, take the gasoline supply into consideration, work out problems in navigation, and so on. The instructor checks and criticizes

he would much rather train a man to fly blind in a Link trainer first, and that the actual air flying would then be merely a logical corollary. We can quite believe that Major Schroeder is right in his views—though the first flying lessons will still be given in an actual airplane for many years to come.—*A. K.*

## Using Exhaust Gases to Aid Propulsion

TWO officers of the Royal Aircraft Establishment at Farnborough, England, are developing a form of jet propulsion whereby the air used to cool the engine, and the heat energy of the exhaust gases, will both be utilized to increase the propulsive effort in an airplane.

The entire engine, with its exhaust manifolds and the radiator, is enclosed inside the airplane wing. Air enters at the leading edge of the wing and passes through the tubular radiator and then over finned exhaust manifolds. In this manner the air cools the radiator, and at the same time takes up energy from the heat of the exhaust. Subsequently it is allowed to expand and is ejected at high velocity through slits in the trailing edge of the wing.

If air is ejected at high velocity at the trailing edge, then a forward thrust must be produced. In other words, the heat of the radiators and the heat of the exhaust have been converted into propulsive energy.

More detailed information, calculations, and tests are necessary before the invention can be accepted completely. But it sounds plausible and may have important possibilities.—*A. K.*

## A Long-Range Ground Direction-Finder

IN its over-ocean flying, Pan American Airways has no radio beacons to rely upon. But its engineers have, as a result of nine years of experimentation, developed a remarkably accurate long-range direction-finder system with a stationary antenna array approximately 150 feet square. Direction of the incoming signal is determined by a search-coil goniometer and errors are kept to a minimum by selecting an electrically satisfactory site. An outstanding achievement of the system is the utilization of short waves for radio direction on ranges up to 3800 miles, a feat hitherto considered impossible. The use of ground direction-finders permits, of course, the installation of far more precise equipment than is possible when the finder is installed in the limited space of an airplane. The airplane transmits a long dash, the ground station determines its bearing position and direction of flight and reports back by wireless. Thus the flight crew is relieved of complex navigational problems. Through Bendix Corporation, the equipment will be made available to other American companies.—*A. K.*

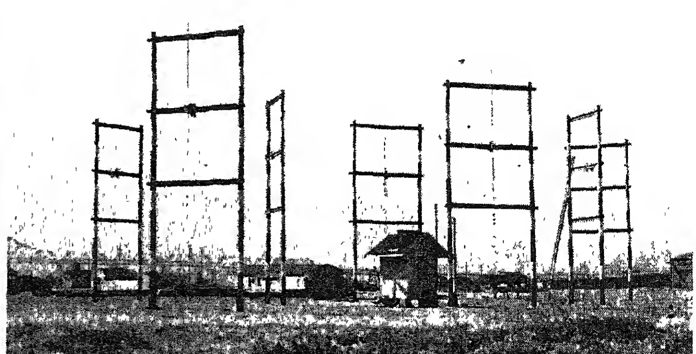
## The Doctors Warn Us

SPEAKING at a recent meeting of the American Medical Association, Dr. Allan L. Barach issued a warning in regard to "oxygen want" which may be experienced in high-altitude flying. The results of breathing for 20 minutes at an altitude of 15,000 feet may be quite serious for persons with latent angina pectoris or other heart troubles. Pilots, picked men of splendid physique, are not likely to be bothered with heart trouble, latent or overt, but their judgment may deteriorate if oxygen is deficient; when a pilot ceases to be alert the way is open to accidents.

Dr. Barach is perfectly right, and his warnings should not be disregarded. But the air-transport operators are fully aware of the perils of "oxygen want." Thus, when pilots are forced to fly at high altitudes for some reason or other for a considerable period of time, the stewardesses are required to watch passengers carefully for any signs of physical difficulty, and to tell the pilot immediately of such symptoms. Pan-American Grace Airways, when flying over the Andes, provides oxygen tubes for both pilots and passengers. On all airlines, co-pilots are carried to give the chief pilots adequate rest. And, finally, airplane constructors are turning to what is the best solution of all—the air-conditioning of cabins by compressing the air almost to its sea-level density by suitable cabin superchargers. Thus the warning of the medical men is being fully met by the precautions of the engineers and operators.—*A. K.*

## Pure Vitamin A by "Molecular Distillation"

A NEW method of distillation, called "molecular distillation," is now being used to distill pure vitamin A from fish-liver oils on a commercial scale. Not only is vitamin A removed as a pure chemical compound from fish-liver oil but the residual oil is at the same time freed from fishy



odor and rancidity in the process. Already this method has yielded vitamin-A esters of 500,000 U.S.P. units per gram and vitamin-A alcohols of 3,000,000 units per gram on a scale large enough to supply about one tenth of the United States' requirement for this vitamin.

Special interest attaches to the method of distillation used. This consists in heating a film of oil moving over a surface to a moderate temperature (100 to 200 degrees, Centigrade), placing a cool surface close to the heated oil film (about 1 cm.), and producing an extremely high vacuum (about $10^{-3}$ mm. of mercury) in the intervening space. The molecules of the heated oil tend to jump out of the layer, and, since the vacuum has removed obstacles to their free travel, they strike and are caught by the cool condensing surface. By making the path between the hot and cool surfaces shorter than the mean free path of the molecules being distilled and by removing from the intervening space as many as possible of the gas molecules which would otherwise fill it and obstruct the travel of those ejected from the oil layer, one can distill materials which cannot be volatilized in ordinary stills and at temperatures far below their decomposition points. This method of molecular distillation has been applied in the past to the separation of mercury's isotopes (atoms of slightly different atomic weights), and to the separation of the heavy hydrocarbons of lubricating oils. Its application to numerous other problems of separation is expected as developments proceed. Its important characteristic is that distillation occurs by the travel of individual molecules which are uninfluenced by others which may be in a mixture. Hence no mutual effects of the different constituents of a solution or mixture are encountered as in ordinary distillation—*D. H. K.*

## How a Country Gets Rich

IN 1908, the average employee of one of the largest tire producers was receiving 40 cents an hour. He could buy a tire for a small motor car for 35 dollars. At that time this tire would run an average of 2000 miles in its lifetime at an average cost of 1.75 cents a mile. A little calculation indicates that an hour's labor would pay for only 23 miles of use of that tire. Thus to run the car with four tires a distance of 23 miles and merely pay for the wear and tear on the tires the worker had to work for four hours. Obviously, few workers owned cars.

In 1936, the average wage of all employees of this plant was 88 cents an hour. Had this been the only gain which took place in the interval, the laborer would still have had to work one hour to secure 50 miles of use from a tire, or one hour's work would have yielded enough income to pay for the wear and tear on the four tires over a 12.5-mile stretch. Car driving would still be a pastime for a few rich people only. However, several other things happened. Instead of the tire costing 35 dollars as it did in 1908, it cost about eight dollars in 1936. Instead of running only 2000 miles, it would run on the average about 20,000 miles. A calculation will indicate that in 1936 an hour's work would pay for not 23 miles of use but 2200 miles, a 95-fold improvement.

# TRANSPORTATION SECTION

price was greatly reduced and the life of the tire increased by 1000 percent. The real gain to labor (and all tire consumers) came not through wage increases primarily, but through a lowering of prices and an improvement in the product. Similarly, the gains have been broadly shared in the case of the motor car itself, electrical appliances, light bulbs, and a host of other things. The rise in the standard of living comes not primarily in forcing upward money incomes, but in raising real incomes.—*Barron's.*

## 16 Cylinders—135 Degrees

An important development in the multi-cylinder motor-car field is the unusual new 16-cylinder Cadillac engine that will be used in the 1938 models. The engine has been built so compactly that it occupies less space than the average straight eight. Its output of one horsepower per 5.7 pounds of weight affords a ratio far better than previous automobile ratings.

To illustrate clearly the engineering behind the new 16, its characteristics are below compared with the 16 that powered the largest Cadillac in the 1937 series:

| | 1938 model engine | 1937 model engine |
|---|---|---|
| Horsepower | 185 | 185 |
| Weight | 1,050 lbs. | 1,300 lbs. |
| Displacement | 431 cu. in. | 452 cu. in. |
| Dis. per 100 lbs. | 41 cu. in. | 35 cu. in. |
| Length | 36 in. | 46 in. |
| Height, excluding accessories | 16 in. | 29 in. |

The V-type principle is applied in the new 16. Here, however, much of the similarity with earlier V-types ends. Cylinder barrels are mounted at an angle of 135 degrees. Two independent sets of accessories, including two cooling systems, are installed. The bore and stroke are amazingly small.

Through use of the 135-degree angle, engineers have been able to achieve a power unit that is virtually flat. This has obvious advantages. First and foremost, the shape creates an extremely low center of gravity. Since the engine is the biggest item of weight in an automobile, its center of gravity largely determines the roadability and safety of the car. Second, with a "flat" motor, the dashboard can be moved forward, increasing leg-room and comfort of front-seat occupants. Third, better cooling is possible. Cylinder banks no longer hamper free air circulation over the top of the engine. The fourth advantage is that the wide "V" offers a roomy and natural cradle for engine accessories.

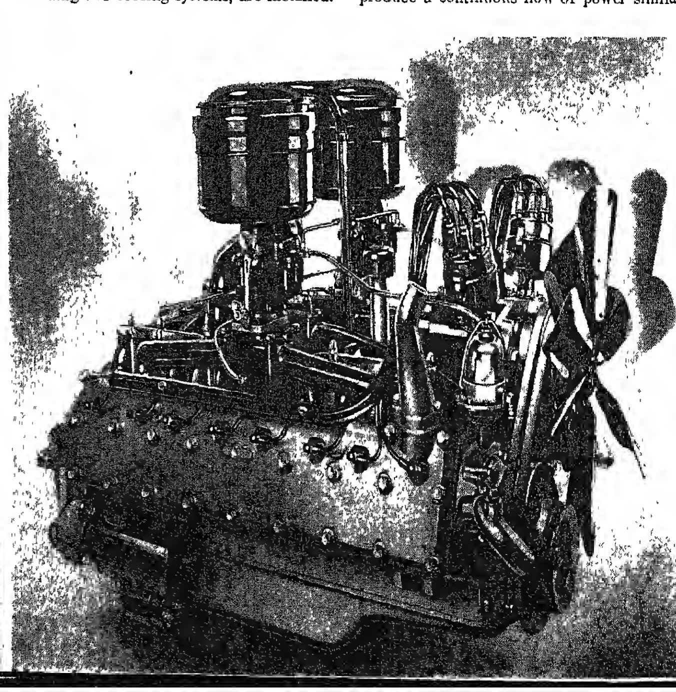
The bore and stroke have the same measurement—3¼ inches, the stroke being the shortest on any automobile and a guarantee of economy and durability. Figures show that each piston inside its cylinder travels only 1590 feet to each mile covered by the car. The average piston travel for 33 American cars over that distance is 2200 feet.

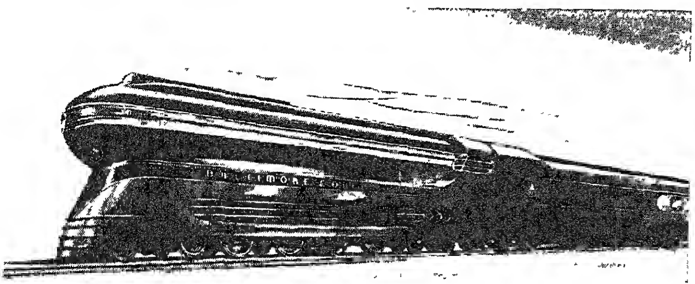
Greater rigidity and increased smoothness have been accomplished by casting the motor in one piece, thus reducing the number of joint surfaces subject to leakage or gasket troubles.

## 16-Cylinder Steam Motored Locomotive

The design of a powerful new locomotive, which is a radical departure from the conventional type, but which nevertheless incorporates fundamental engineering and mechanical principles whose efficiency has been amply proved, has just been completed by the Baltimore and Ohio Railroad.

Built with 16 cylinders arranged for constant torque propulsion, the locomotive will produce a continuous flow of power similar





How the B&O 16-cylinder locomotive will appear when in service

to that of a multi-cylinder automobile—with smooth running and minimum vibration. It is believed that it will develop 5000 horsepower, and that it will be capable of handling 14 standard Pullman cars at a speed of 100 miles per hour on straight, level track.

The locomotive will have a 4-wheel front truck, four pairs of drivers, a 4-wheel trailer truck, and a tank mounted on two 6-wheel trucks and carrying 23 tons of coal and 22,000 gallons of water.

Each of its four driving axles will be driven by a Besler steam motor and each motor has four cylinders directly geared to its axle, so that there will be a total of 16 cylinders with 32 power impulses for each revolution of the steam motors. No counterbalancing of any kind, and no main and side rods and crank pins, will be required, this new design thus entirely eliminating the hammer blows on tracks that result from counterbalance weights. The absence of main and side rods and other motion work, will also make it possible for the driving wheels, with their independently mounted 4-cylinder steam motors, to accommodate sharper curves than will locomotives of conventional design.

The gears and all other motion parts of the steam motor will operate continuously in a bath of oil forced by a pump to the wearing parts, as is done in the modern automobile. The cut-off position of the valve gear, together with forward and reverse motion, will be automatically regulated from the locomotive cab by means of an electro-pneumatic control.

Total weight of the locomotive will be about 400,000 pounds, with 260,000 pounds on the drivers. The starting tractive power will be 72,500 pounds, giving a factor of adhesion of 3.6, which is more than ample where there is constant torque.

The boiler will be of the Emerson water-tube firebox type with 775 square feet of heating surface in the firebox, and a total heating surface of 5800 square feet. It will have a superheating surface of 1530 square feet, will be equipped with feed water heater, and will have a capacity of 115 percent. The Besler steam motors operate on a guaranteed rate of 14 pounds per horsepower-hour, so that when the locomotive is developing 5000 horsepower, the cylinders will require 70,000 pounds of water per hour while the boiler will evaporate 80,500 pounds. The working pressure of the engine is 350 pounds.

The new locomotive will be very flexible. It will have outside frames and spring rigging; also outside journal boxes, which will be oil lubricated. Each pair of driving wheels with its attached steam motor can be quickly removed on the drop pit for necessary repairs, such as turning of tires, ad-

The locomotive will be streamlined on the pattern developed for the Baltimore and Ohio two years ago by Otto Kuhler, consulting engineer of design, and which has been used in an adapted form for the streamlining of the railroad's Diesel-electric locomotives and its New York train-connection motor coaches.

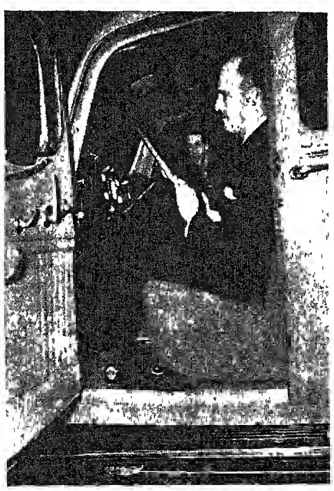
**BLACK**

**ONE motor car company reports that black is gradually losing its place as the favorite color for automobiles, the indications being that the American public is going in for greater diversification of color. Gun-metal gray, in fact, led black up till last January on the 1937 cars of this maker.**

## Are Your Brakes Right?

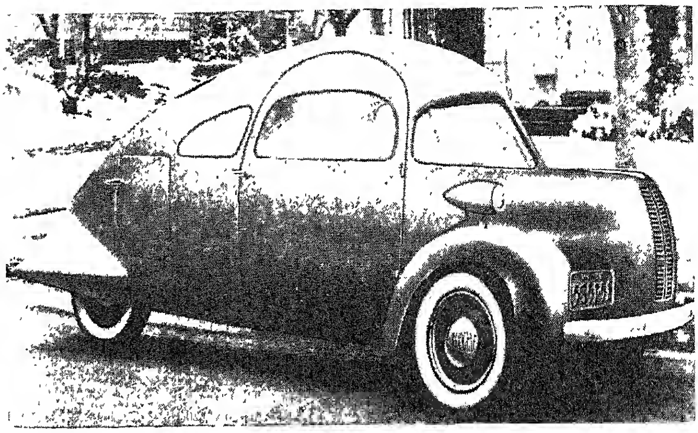
TESTING the efficiency of a motor car's brakes is now as simple a matter as checking the oil, through the development of the Decelometer, a little instrument that flashes a green signal when the car stops within a safe, legal distance, and a red signal when the brakes are inefficient.

Declared to be more accurate than previous types of instruments designed for the



Using the Decelometer

same purpose, the Decelometer checks within 0.7 percent degree of error, as against 10 percent which hitherto has been regarded as commercially acceptable for gages performing a similar function. It has already been approved by motor vehicle authorities of the states of New Jersey and Connecticut, as well as by members of the Society of



The "Airomobile"—three wheels, front-wheel drive, streamlined

of the National Bureau of Casualty and Surety Underwriters, according to R. J. Alden, its inventor.

Developed in collaboration with engineers of the General Electric Company, who designed its intricate molded plastic parts and deceleration-actuated mercury-switch mechanism, and scientists of the U. S. Bureau of Standards, who resolved the mathematical equation on which its operation is based, the Decelometer resembles in general appearance a common, tubular two-cell flashlight. On its face are two small circular windows, one green, and the other red. Inside is the working mechanism.

During the testing operation, the Decelometer is placed on the floor of the car, directly in front of the inspector. A sharp set screw at the rear of the instrument holds it firmly fixed in position. When the brakes of the car under test are applied, the motion of the vehicle propels a column of mercury forward in its channeled groove, thereby effecting a mercury-switch action, and establishing contact with one or the other of the signal lights, operated by dry cells. If the forward motion caused by quick stopping is sufficiently fast to indicate proper braking efficiency, the green signal flashes; if not, only the red signal shows. The complete test requires only a few moments.

## Another Teardrop

THE car in an accompanying illustration, representing almost the acme in streamlined design, is the "Airomobile," designed and built by Lewis American Airways, Inc. It has recently undergone strenuous road tests, and is expected shortly to go into production. The main features are the use of three wheels instead of four, front wheel drive, air-cooling, and light weight (1500 pounds empty—which, with the "tear-drop" design, enables it to run 40 miles to a gallon of gasoline at normal speeds). It is said to be capable of a safe driving speed of 80 miles per hour, and is designed to sell at an extremely low price when in regular production.

The motive power is a four-cylinder, opposed, 60-horsepower engine, produced by the Doman-Marks Engine Co., specialists in air-cooled design. In the gears of the transmission, which is furnished by the New Process Gear Company, as well as in other vital parts throughout the car, such as valves, crankshaft, and so forth, nickel alloy steels were specified to secure dependable strength and light weight.

A factor is the use of "Ni-Resist" cylinder sleeves, which are pressed into the aluminum alloy cylinders. Ni-Resist has practically the same coefficient of expansion as aluminum, hence extremely close tolerances (.001 inch maximum) are permitted between the pistons and liners. With ordinary cast-iron cylinders or blocks, and aluminum pistons, it is necessary to allow a .003 inch clearance when cold, which gives rise to "piston slap" before the engine is warmed up; but the use of the Ni-Resist sleeves obviates this difficulty.—*Nickel Cast Iron News.*

## Inter-Continental Highway

BLAZING a trail across two continents, which may overcome, within half a dozen years, many of the present physical barriers between the two Americas, the Brazilian Highway Expedition recently visited several of the leading industrial plants of Akron, Ohio, while en route to New York, northern terminus of the proposed inter-continental highway.

It was nine years ago that the expedition set out from Rio de Janeiro and the only contact the members have had with their home country since 1928 was a telephone conversation from Chicago, three months ago, with the editor of a daily newspaper in Rio.

In their travels through 15 countries, they have been received by 14 presidents and expect to have an audience with President Roosevelt at Washington. They have prepared 34 maps and charts of the proposed route of the Pan-American Highway and, at Washington, expect to offer a complete set of their maps and other information to the Pan-American Union.

About 10,000 miles of the 16,182 miles on the proposed highway are now open to motor traffic and, from assurances of co-operation by the various countries traversed, it is expected that the route will be opened south to Honduras within two years and that the entire project will be completed in six years.

The Pan-American Highway would enter the United States at Laredo, and extend from there to Austin, Dallas, Little Rock, Memphis, St. Louis, Springfield, Chicago, Detroit, Cleveland, Akron, Pittsburgh, Washington, Philadelphia, and New York, enabling South American visitors to this country to traverse the most important industrial

The expedition has received both moral and financial support from all of the countries in which it has made surveys and studies of the route, and several of the countries have already improved their sections of the 16,000 mile highway.

Where more than 30 similar expeditions have attempted the same undertaking and failed, the present expedition sees the end of the nine-year trip already in sight. Besides Commander de Oliveira, its members are Francisco Lopez de la Cruz, of Rio de Janeiro, observer; Mario Fava, mechanic and technician; and S. W. White, of Dallas, Texas, interpreter and editor and publisher of the *Pan-American Ambassador*, of Monterey, Mexico.

The expedition travels in Model T Fords, in which they traversed almost impassable stretches of country in Central and South America. For weeks at a time, they lived on parched corn, roots, and had no drinking water except what they obtained from stalks of the bejuco tree.

When gasoline was not available they ran the cars on kerosene mixed with alcohol and lubricated them with hog-lard. At times they had to hew tunnels through dense vegetation just large enough for the cars to get through but so thick overhead that sunshine could not penetrate.

Upon their arrival at New York, they expect to return to South America by boat to continue their efforts to complete the huge project.

*(End of Transportation Section)*

## New, Mysterious Disease

The strange case of a man whose bones have turned pale red is reported by Dr. Eugene Freedman of Cleveland. The patient's bones show other changes besides that of color, and the bone marrow has been replaced by fibrous connective tissue. Hip bones, vertebrae, and shoulder blades are affected. The condition has been going on for 12 years, starting when the patient was 16 years old. Although the disease has been progressing, the young man is not incapacitated by it. Dull, aching pains in the back and joints are the symptoms that have brought the patient into the hospital from time to time for treatment. Each time thorough study by X-ray, chemical, and microscopic methods have been made, but the doctors still do not know the true nature of the disease or its cause.

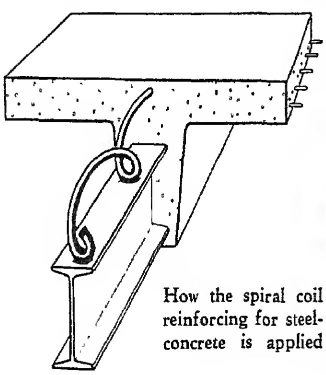
## Alcohol From Artichokes

Utilization of farm crops for industrial purposes has focused attention on the Jerusalem artichoke as a potential source of sugar to be converted into alcohol. Recent experiments in converting these tubers into alcohol have been made at the Iowa State College with very attractive results. The yields of artichokes per acre are high, varying from 15 to more than 20 tons per acre in the state of Washington (the ... of three test locations). The average ... a... 14 ...st farms in Illinois, Washington, to ... tion ... Columbia varies from 11 to ... aver... gallo... The tubers contain 15 ... ha... ...ler favorable condi... fields ... ...nd alcohol recovery, & Bro... with corn, which yields from 30 to 35 bushels per acre from which 75 to 87 gallons of alcohol can be made, the advantage of artichokes is apparent. The Jerusalem artichoke (*Helianthus tuberosus*) is a native American crop and has been suggested as a source of levulose (fruit sugar). The present effort to grow this crop as a raw material for alcohol manufacture appears as a promising method of increasing farm income through the production of an industrial raw material.—*D. H. K.*

## Spiral Reinforcing for Steel-Concrete

A new method of concrete construction which insures a positive bond with reinforcing steel, called the "Alpha System," has been introduced by the Porete Manufacturing Company. Use of this new system permits the contractor to obtain the advantages that are inherent in both steel and concrete construction.

In the Alpha System a spiral coil is welded to the top of the I-beam so that the con-



How the spiral coil reinforcing for steel-concrete is applied

crete slab is solidly anchored to the steel beam, as shown in the illustration, and both work in unison. To carry the same load as before, a much smaller steel beam can be used, because the concrete slab takes care of the compressive stresses produced by the superimposed load, the same as in a reinforced T-beam. This results in a saving of 40 to 75 percent in the weight of the steel and a great saving in the cost of the complete construction. This system combines the greater rigidity of reinforced concrete with the simplicity of steel construction, and is adaptable to all kinds of fireproof buildings, particularly those with heavy loads and long spans. It is particularly recommended also for bridge construction.

## Fire Resistant Lacquer

Matches, cigars, and cigarettes do not affect a new baking lacquer recommended for finishing metal ash trays and similar articles. The lacquer also resists perfume, alcoholic liquors, and other ordinary hazards.—*D. H. K.*

## X-Ray Snapshots

A new device for use with ordinary X-ray machines to take X-ray snapshots of the heart and lungs is described by Dr. Siegmund Strauss of Vienna. The new device is called the Telecord and is controlled by the heart.

Ordinary X-ray machines are not quick enough to take a clear picture of the heart

tails necessary for diagnosis of certain heart disorders, particularly during early stages of the ailments, are lost. Very powerful machines have been built which will take X-ray snapshots, but the advantage of the Telecord is that, when it is used with the ordinary machine, well-defined pictures of the lungs and clear contours of the heart are obtained.

"The essential thing about this equipment," Dr. Strauss explained, "is that not only one single exposure but four or five short time exposures in rapid succession immediately dictated by the pulse can be taken. These partial exposures add up and cover each other on the film in such a way that all partial exposures equal one total exposure."

The pulse or beat of the heart is picked up at the wrist by a compression cuff, transmitted to the machine, amplified, and used to control the apparatus.

## Enamel for Concrete

A NEW enamel for concrete, which prevents dusting, produces a high permanent gloss and is resistant to moderate wear, is now being made with a synthetic resin base derived from rubber. Its superiority over oil paints is due to the fact that no chemical action occurs between the lime salts in the concrete and the resin itself.—*D. H. K.*

## Brightness Meter

BRIGHTNESS and brightness-contrasts are of fundamental importance in making objects visible; hence brightness meters are important measuring tools. A new compact brightness meter weighing only 2½ pounds, in a Bakelite case 1¾ by 4¼ by 8¾ inches, has recently been developed by M. Luckiesh and A. H. Taylor of the Lighting Research Laboratory, General Electric Company, Nela Park, Cleveland. The range of brightnesses which can be measured is over twenty million to one, and includes all brightnesses from the low level of pavement brightness on the street at night up to the bulb brightness of a 100-watt frosted lamp. Objects as small as one foot wide can be measured from a distance of 500 feet.

The photometric field of the meter, viewed through an eye-piece at one end, consists of two small trapezoids in a larger circular field. They are separated by a narrow vertical space. By means of an adjustable lens the test-object to be measured is brought into sharp focus in the space between the trapezoids and in the surrounding field. The brightness of the trapezoids may be varied until they match in brightness the object being measured. The brightness scale is viewed through an eye-piece just below the one through which the photometer field is viewed. Two brightness scales are seen, giving the brightness in candles per square inch and in foot-lamberts.

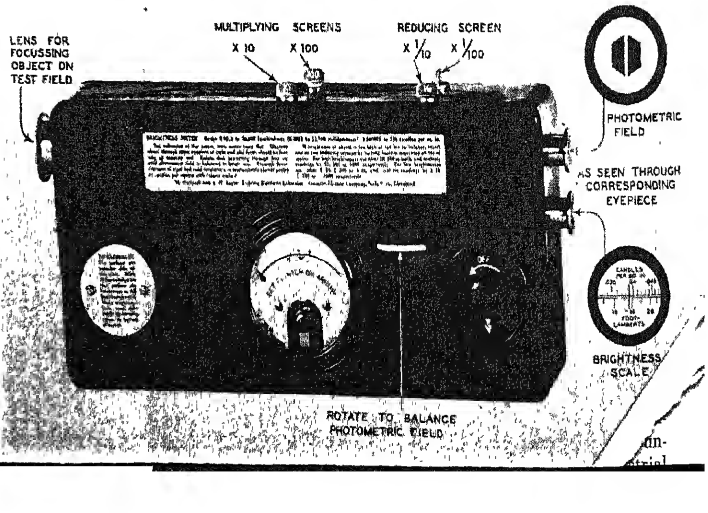
Because of its portability and great range the meter should prove very useful in many fields, both indoors and outdoors. For example, it can be used to measure the brightness of the street pavement at night in appraising visibility and lighting; to measure the brightness of various objects indoors, including lighting fixtures; and in photography, to measure the brightness of objects to be photographed so as to gage the exposure.

**SQUARE**

IT would be quite proper to call 1936 the squarest year because—1936 is the square of 44, 1 is the square of 1, 9 the square of 3, 36 the square of 6, 16 the square of 4, 196 the square of 14, 361 the square of 19, 169 the square of 13, and 961 the square of 31.

## Skilful Reading Requires Fewest Eye Motions

MORE than 100,000 eye muscular adjustments are required by the average good reader in a single hour's perusal of non-technical material, it was made known by Bureau of Visual Science experts of the American Optical Company, in announcing results of a study just completed demonstrating the huge muscular load placed upon eyes of persons engaged in near-point work. The Bureau based its figures on such a reader being able to scan and comprehend the written word at the rate of 350 words per minute. In the case of what it classed as "poor" readers, the Bureau estimated the number of required eye muscular adjustments more nearly to average the huge total of 200,000 per hour.



# CURRENT BULLETIN BRIEFS

*(Bulletins listed as being obtainable through Scientific American can be supplied only by mail)*

PRINCIPLES OF PUBLIC ADDRESS SYSTEMS, by M. N. Beitman, the second revised edition, gives a complete background for setting up and operating various types of public address systems. It is supplemented by a series of circuits involving varied numbers of tubes for sound amplification. Complete and thorough-going. *Write for Bulletin 1237A, Scientific American, 24 West 40th Street, New York City.—50 cents.*

DISEASES OF FUR ANIMALS, Farmer's Bulletin No. 1777, is of particular interest to both fur farmers and the fur trade. Standardization and intensification in fur production and a more critical market are calling for pelts of a quality that can be produced only by animals in good health. The progress that has been made in treating fur animal diseases is presented in this 22-page illustrated bulletin. *Superintendent of Documents, Washington, D. C.—5 cents (coin).*

STEEL HARD-FACING PROCEDURE tells briefly and concisely how the oxy-acetylene torch is used in hard-facing steel with Haynes Stellite. Step-by-step instructions are given, and the text is amplified by pertinent photographs and drawings. *Write for Bulletin 1237B, Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

BLACK LIGHT EQUIPMENT is a folder telling of the uses of black light lamps in connection with luminescent paints. It also describes the lamps and accessories. *Science Laboratories, Inc., 424 East Fourth Street, Cincinnati, Ohio.—Gratis.*

MORE MONEY IN RADIO is an informative booklet dealing with the present opportunities in the radio field. It outlines the numerous branches where opportunities exist and the possibilities for men who are equipped with the necessary knowledge and background. *Sprayberry Academy of Radio, 2548 University Place, N. W., Washington, D. C.—Gratis.*

LITERATURE on vibration pickups of typical piezo-electric Rochelle salt crystal design is now available. These devices are applicable to the study of noise and vibrations in various industrial applications. For literature address *The Brush Development Co., 3311 Perkins Avenue, Cleveland, Ohio.—Gratis.*

STATUS OF RURAL-SCHOOL SUPERVISION IN THE UNITED STATES IN 1935-36, by W. H. Gaumnitz, has been published to show the progress that has been made in the "little red schoolhouse." Pamphlet No. 72 of the United States Department of the Interior, Office of Education. *Superintendent of Documents, Washington, D. C.—10 cents (coin).*

COMMUNICATIONS is the first issue of a magazine which combines three others that have long been well-known in their own fields—*Radio Engineering, Communication & Broadcast Engineering,* and *The Broadcast Engineer.* Publishers felt that the three publications had become so definitely linked that a single magazine covering these overlapping fields was an obvious venture. *Bryan Davis Publishing Co., Inc., 19 East 47th Street, New York City.—Subscription price $2.00 per year in the United States and Canada, $3.00 in foreign countries.*

PAPERS PRESENTED AT THE TWENTY-FOURTH ANNUAL CONFERENCE ON HIGHWAY ENGINEERING presents some of the thoughts of the country's foremost authorities in this particular field. It covers such phases as highway planning, landscaping, the beautification of city streets, co-operation in highway research, safety, traffic signals, and so on. Circular No. 30, *Engineering Experiment Station, University of Illinois, Urbana, Illinois.—50 cents.*

MASTER ANTENNA SYSTEM MANUAL deals with the theory, installation, and operation of up-to-date radio antennas for apartment houses and other large buildings, as well as for individual dwellings. *Write for Bulletin 1237C, Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

ARCHEOLOGY OF ST. LAWRENCE ISLAND, ALASKA, is a detailed study of the Eskimo culture of an island near Bering Strait. *Smithsonian Institution, Washington, D. C. —$2.00.*

THE FINEST AUTOMATIC HEAT THAT MONEY CAN BUY is the title of an illustrated booklet that presents facts about automatic coal heating in the home. A number of illustrations amplify the text and show what may be expected with the use of automatic heating. *Request Book 1469-B from Link-Belt Company, Stoker Division, 2410 West 18th Street, Chicago, Illinois.—Gratis.*

CLAROSTAT SERVICE MANUAL is a pocket-sized book, containing over 200 pages, which gives circuit diagrams, servicing hints, ballast data, and other valuable information for the radio service man. *Free to service men writing on business stationery to Clarostat Manufacturing Company, Inc., 285 North Sixth Street, Brooklyn, New York.*

SAFETY SEALED IN CONCRETE presents a plea for the use of concrete in the construction of highways, and shows the safety features of this type of surface. *Write for Bulletin 1237D, Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

LOCAL BIRD REFUGES, by W. L. McAtee, deals with the establishment of local refuges as a means of attracting birds. It is adapted for use throughout the entire United States. Farmers' Bulletin No. 1644, *Superintendent of Documents, Washington, D. C.—5 cents (coin).*

IRVING DECKING, THE OPEN STEEL MESH PAVEMENT FOR BRIDGES presents in short text form, illustrated with many photographs, the advantages of this open mesh pavement, which is handled in units and is

finished it becomes virtually a one-piece open steel mat over the entire bridge floor. *Write for Bulletin 1237E, Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

FACTS AND FIGURES OF THE AMERICAN CHEMICAL INDUSTRY is published as Part II of a regular edition of *Chemical & Metallurgical Engineering.* It gives voluminous data on the subject indicated in its title. *Chemical and Metallurgical Engineering, 330 West 42nd Street, New York City.—75 cents.*

DEVELOPMENT VS. EXPOSURE, by Herbert C. McKay, explains why no photographic developer is a complete processing factor in itself. The photographer must always consider the influence of the exposure, the speed rating of the film itself, and quality vs. fine grain. The subjects discussed include development control, stabilization, surface development, length of developer life, and so on. *Write for Bulletin 1237F, Scientific American, 24 West 40th Street, New York City.—3 cents.*

PROBLEMS IN BUILDING ILLUMINATION, John O. Kraehenbuehl, deals particularly with lighting problems as they may apply in the industrial, commercial, and public building fields. It does not deal with specific solutions, but with the general principles that underlie the necessity for good lighting and with the problems presented in obtaining such lighting. Circular No. 29, *Engineering Experiment Station, University of Illinois, Urbana, Illinois.—35 cents.*

# THE NEW HEAVY NITROGEN

(*Continued from page* 346)

and use of the phosphorus take place within the body of the rat, the animal can be killed and its various tissues analyzed. The photoelectric cell indicates the presence of the phosphorus whose rays label it. By this method, it has been determined that, for all their apparent stability, the bones are continually exchanging old atoms for new atoms. Soon after feeding, radioactive phosphorus was discovered to be already part of the bony structure—an entirely unsuspected phenomenon. Even teeth, sooner or later, trade their constituent atoms for fresh arrivals. Still more astonishing, ten hours after the administration of radioactive phosphorus to rats, their brains had incorporated the tagged atoms into living brain substance! Further, the brain molecules of which phosphorus forms an important part do not give one phosphorus atom in exchange for another. It must be concluded, therefore, that, contrary to earlier theory, these phosphorus-containing brain-molecules are in constant turmoil, being broken down and synthesized anew every few instants. Labeled molecules are helping us directly to read some of the answers to the most mysterious of all problems: how atoms, by merely hopping to and fro can realize—be conscious of—their activities; and in the form of brains use their fellow atoms to learn more about mind's place in the universe.

On the more immediately practical side, similar determinations are improving our understanding of the differences between healthy and diseased tissues, and upon the action of certain drugs administered in medical practice. It has been proved that cancer cells retain more bismuth than do healthy cells. Bismuth and also lead are helpful portions of certain drug molecules. How does the body dispose of these metals and how quickly? Artificially radioactive bismuth and lead are providing this information, which will lead to more efficient medical methods. And, of even greater significance to medicine, the most exact measurements of blood volume and rate of blood circulation in the history of science are being set forth—as only atom-tags could.

In this great new field of science, the op-

ties of life's activities. Yet, even the first and comparatively simple discoveries which have been made indicate that physics and chemistry are experiencing a startling awakening, like their awakening at the beginning of this century. About 1895, scientists were saying that the only work left them was more precise measurement—all the great principles were already on the library shelf. The force of gravity, the speed of sound and light, the weight of a given atom: increased accuracy here was thought to be the whole dry-as-dust future. Then in relatively quick succession came our great discoveries of radioactivity, the intricacy of the atom's heart, the transmutation of the elements, relativity, and the transformation of matter into energy. So today the future is black with vast hosts of baffling problems.

While physics and chemistry were being reborn, the science of life was progressing rapidly too: the application of physico-chemical methods to biology explained life's secret after life secret. Hence scientists began to say: Life is no more than an example of the play of the laws known to physics and chemistry. But in the last few years, bio-science has been teaching rather than learning from physics and chemistry. Bio-scientists have, to the amazement of the scientific world, exhibited molecules of genes, viruses and enzymes that not only reproduce like a living thing, but even control the activities of countless other molecules, and with supreme harmony. Now, chemists and physicists are learning from biologists that there are important physiological—and perhaps chemical—differences between varieties of the same atom. Finally, and above all, it is being made clear, especially by studies with tagged molecules, that on the plane of life practically every known law of physics and chemistry is involved—in phenomena that are the highest illustration of the play and interplay of the forms of energy known to physics and of the forms of matter known to chemistry. Mendelejeff first satisfactorily grouped the chemical elements into families. If he were alive today he would, in revising his classification of the elements, take especial note of their rôles in the loftiest drama of which physics and chemistry are aware: the drama

# LEGAL HIGH-LIGHTS

## Patent, Trade Mark, and Related Legal Proceedings That May Have a Direct Effect on Your Business

By ORSON D. MUNN, Litt.B., LL.B., Sc.D.
New York Bar
Editor, Scientific American

### PATENT INJUNCTIONS

WHEN a patentee prevails in a suit for infringement of a patent he is entitled to an injunction restraining further infringement of the patent.

The question frequently arises as to whether a patentee can obtain a preliminary injunction restraining infringement pending the trial of the case. As a general rule the courts refuse to grant preliminary injunctions in suits for patent infringement unless the validity of the patent in suit already has been sustained in prior litigation or unless there is very strong proof of long acquiescence by the trade in the validity of the patent. Thus, in a recent suit for infringement of a design patent the plaintiff applied for a preliminary injunction restraining infringement pending the trial of the case. The patent had not been litigated before and as it was but recently granted there was no evidence of long acquiescence. The court accordingly refused to grant a preliminary injunction, stating:

"The mere presumption of validity attaching to the patent from the fact of issuance by the Patent Office is not strong enough to win an injunction on the threshold of the suit. An adjudication by a court in a prior contested suit is generally accepted as settling the point of validity sufficiently to warrant a preliminary injunction in a later case, provided also, of course, the proof of infringement is convincing; and long acquiescence in the trade may serve as well as a prior adjudication."

### SHREDDED WHEAT

THE manufacturer of the well-known biscuit, Shredded Wheat, was awarded an injunction by the Circuit Court of Appeals for the Third Circuit, restraining a competitor from using the name "Shredded Wheat" and from advertising or offering for sale a biscuit in the same form and shape as the Shredded Wheat biscuit.

The case involved several important points of law. As a matter of fact the issues were so complicated that the Court first refused to award an injunction and then upon a re-argument it reversed itself and granted an injunction.

One of the principal defenses was that the product known as Shredded Wheat had been patented in 1895 and that upon the expiration of the patent the name passed into the public domain along with the product, with the result that the defendant and the rest of the public had the right to use it. The Court gave this defense serious consideration and agreed that where during the life of a patent a name has become the name passes to the public with the expiration of the patent. However, it found that in the case under consideration the public failed to avail itself of the right to use the name after the patent had expired and thereafter, due to the extensive advertising of the manufacturer of Shredded Wheat and also due to the failure of the defendant and the rest of the public to avail themselves of the name, the name "Shredded Wheat" had become exclusively identified with the product of the plaintiff. The Court then concluded that the trade mark "Shredded Wheat" was valid and was the exclusive property of the plaintiff.

Even more far reaching was the portion of the decision which restrained the defendant from advertising or offering for sale a biscuit in the form and shape of plaintiff's biscuit. It appears that the biscuit had formerly been protected by a design patent and that the design patent had expired. Under general principles of patent law, upon the expiration of the patent the subject-matter thereof becomes public property. The defendant naturally contended that since the design patent had expired he had the right to make a biscuit in the exact form shown in the design patent. The Court rejected this contention on the grounds that the design patent had been adjudged to be invalid prior to its expiration, and on the further grounds that the plaintiff and its predecessor had used the particular form for the biscuit for 40 years and equity would not permit it to be copied.

### NO REMEDY

A SUIT cannot be maintained for infringement of a patent application. The monopoly provided for in the patent statutes is not effective until a patent is actually granted. This is so elementary that the question seldom arises in the courts. However, the question recently was presented to a district court in a suit brought by a dress manufacturer against a competitor, charging infringement of a design patent application. The Court dismissed the suit, stating:

"No patent has been issued for the dress style in question. Until a patent has been issued, an infringement suit will not lie."

### NOT FAIR

IN a recent suit brought by the New York World's Fair Corporation, a publisher was restrained from using the title "World's Fair News" on a magazine.

The New York World's Fair Corporation is a quasi public corporation organized to plan and operate the World's Fair in New York City in 1939. The court found that so Fair that the words had acquired a secondary meaning and indicated the particular World's Fair that is to be held in New York City in 1939. On the ground that there was danger of confusion between the publisher of the magazine and the New York World's Fair Corporation the use of the name "World's Fair" on the magazine was enjoined.

### PRICE DISCRIMINATING CONTRACTS

A NEW York State Court has held that a plea of violation of the Robinson-Patman Act is not a defense in a suit for breach of contract for the sale of merchandise.

The Robinson-Patman or Anti-Price Discriminating Act is a Federal law amending the Clayton Anti-Trust Act and it prohibits discrimination in price, under certain circumstances, in the sale of merchandise in interstate transactions. In the case under consideration the defendants pleaded that the contract violated the Robinson-Patman Act in that the plaintiff had charged lower prices for identical merchandise to competitors of the defendants. The court held that the Robinson-Patman Act did not render the contract illegal and that it was enforceable under the laws of the State of New York.

### TELEPHONE DIRECTORIES

A COPYRIGHT on a telephone directory was held to be valid in a suit decided by the Federal Court of Appeals in California.

The telephone company had prepared a telephone directory of the usual type and had duly copyrighted it. From the list of names and numbers contained in the telephone directory the infringers prepared a directory in which the telephone numbers were arranged in numerical sequence followed by the names of the subscribers. The telephone company charged that rearranging the listings of the telephone directory in this manner and publishing them constituted copyright infringement. The infringers claimed that the copyright on the telephone directory was invalid and that regardless of this, since their directory radically differed from the telephone directory, their use of the telephone directory as a source of information was fair use, and did not constitute copyright infringement. The Court rejected both of these contentions. It first held that directories were proper subject matter for copyright and in this connection stated: "That a directory may be copyrighted is well settled. The principle is recognized in the statute ****"

With regard to the defense that the defendants had made only fair use of the telephone directory the Court stated: "The inversion, without license, is not permitted merely because the holder of the copyright has not so used it."

A question of human, if not legal interest also arose in this case. The infringers were husband and wife. The wife presented the further defense that she was merely an employee of her husband and exercised no discretion, judgment or responsibility as to the conduct of the business. The Court held that this defense was without merit, and found that the wife took an active part in

# Books
## SELECTED BY THE EDITORS

### NEW FRONTIERS OF THE MIND

*By J. B. Rhine*

THE card matching and calling tests at Duke University—some described in this magazine, others in technical books that were rather hard to read, still others in the new magazine *Parapsychology*—are now famous. Taking the investigation of telepathy and clairvoyance wholly out of its old environment of hocus-pocus, and into the scientifically controllable surroundings of the laboratory of the university, the author has shown that both telepathy and clairvoyance do occur (which is not by any means to make claim that whatever the charlatan says he has done is likely to be so). The present volume tells in a plain, straightforward and entertaining style—just as one might tell it orally—how all these tests were conducted and what happened. There is nothing whatever about alleged physical psychic phenomena—table tipping, trumpet stunts, materializations, and so on—or of spirit communications. This research is confined strictly to a study of extra-sensory perception between the minds of ordinary living persons, chiefly average college students and instructors; also perceiving inverted cards. There is no smell of occultism or medieval mysticism about the Duke experiments.—$2.65 postpaid. —*A. G. I.*

### THE NEWER ALCHEMY

*By Lord Rutherford, Prof. Exper. Physics, University of Cambridge*

IN this little book the famous physicist describes the different methods used in transmuting the elements, and discusses the considerations surrounding the subject.—$1.60 postpaid.—*A. G. I.*

### THE AMERICAN ANNUAL OF PHOTOGRAPHY, VOLUME 52

*Edited by Frank R. Fraprie*

PHOTOGRAPHIC annual time is here again. First of the lot to reach this reviewer's desk is the 1938 edition of the dean of all photographic annuals. As usual, it presents a series of almost 100 outstanding photographs which were selected by the editor from over 7000 prints. Accompanying them is a series of articles on up-to-date phases of modern photography, written particularly for the serious-minded amateur. One of these that deserves special mention is entitled "Studio Portraiture with a Miniature Camera." In this particular section the reader is shown the various types of portraits and accompanying

awings indicate exactly how they were lited. There is, of course, the usual lpful appendix of the latest formulas d photographic information.—$2.40 stpaid.—*A. P. P.*

CIENCE EXPERIENCES WITH OME EQUIPMENT

*y C. J. Lynde*

UT several tiny boats out of paper with a slot at the stern of each, lace a piece of camphor in the slot of ach and watch the boats propel themelves in a tub of water. Invert a tumbler uickly over a piece of burning tissue n a vessel filled with water and watch he water being forced upward into the lass. These two samples of simple home ricks easily explained by simple physical laws are given to show the general ype of the 200 experiments in this volme. Each experiment is illustrated with rawings which show exactly how it is erformed. A key to the reasons for each henomenon is contained in the back of his neat little volume. For young boys and grown-up boys.—$1.35 postpaid.—*F. D. M.*

THE MAKING OF A SCIENTIST

*By Raymond L. Ditmars*

RECOLLECTIONS and adventures of a famous naturalist. Easy, pleasant eading, humorous and chatty, covering incidents connected with boyhood ollecting and attempted menagerie eeping in a New York apartment, also ater episodes with rattlers, monkeys, ears, giant bats, snakes, the paradox rog, and other animals. A book that vould make an elderly reader wish he ad been a naturalist, or lead a youth o decide to become one.—$2.90 postaid.—*A. G. I.*

THE TRAFFIC IN HEALTH

*By Charles Solomon, M. D.*

A DISCUSSION, rather lively and pointed, of patent medicines and osmetics. The patent medicine racket d what to do about it; disease and its eatment; habit-forming, sleep-producg, and pain-killing drugs; the science nutrition and the lunacy of diet fads; e habits of the digestive tract; too fat too thin; infections and antiseptics; smetics—these are the contents. Other oks, written by laymen, have lambast- the quack racket, but the present one y a physician. The author is fearless ames names without evasion or equiveation.—$2.95 postpaid.—*A. G. I.*

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